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TM 9-1730B

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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ORDNANCE MAINTENANCE

CROSS-DRIVE TRANSMISSION

MODELS CD-500-3 AND -4
(ALLISON-GM)

DEPARTMENT OF THE ARMY • APRIL 1952

UNCLASSIFIED

CHANGE

No. 1

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DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 20 November 1968

Ordnance Maintenance

CROSS-DRIVE TRANSMISSION

MODELS CD-500-3 AND-4 (ALLISON—GM)

TM 9-1730B, 3 April 1952, is changed as follows:

Page 298, paragraph 100. Subparagraph *e* is superseded as follows:

Figure No.	Reference letter	Point of measurement	Size and fit of new parts	Wear limits
414	M	Cone.....	0.122 to 0.126	0.112

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PER DA CIR 310-86, 10 Jun 76

By Order of the Secretary of the Army:

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General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-37, organizational maintenance requirements for Gun, Self-Propelled, 40MM (Twin) M42, M42A1; Tank, Combat 76-MM Gun, M41, M41A1, M41A2; Tractor, Full-Track, High Speed, M8A1, M8A2; Howitzer, 105-MM, M52, M52A1, Howitzer, 155-MM, M44A1 and Carrier, Personnel, M75.

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ORDNANCE MAINTENANCE
**CROSS-DRIVE
TRANSMISSION**

MODELS CD-500-3 AND -4
(ALLISON-GM)



DEPARTMENT OF THE ARMY

APRIL 1952

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WASHINGTON 25, D. C., 3 April 1952

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BY ORDER OF THE SECRETARY OF THE ARMY:

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The Adjutant General

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of personnel responsible for field and depot maintenance of this matériel. These instructions contain information on maintenance which is beyond the scope of the tools, equipment, or supplies normally available to using organizations. This manual does not contain information which is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operator's technical manuals or field manuals.

b. This manual contains a description of and procedure for removal, disassembly, inspection, repair, rebuild, and assembly of the cross-drive transmission, models CD-500-3 and -4. The appendix contains a list of current references, including supply catalogs, technical manuals, and other available publications applicable to the matériel.

c. TM 9-730, or other pertinent operator's manuals, contain operating and lubricating instructions for the matériel and contain all maintenance operations allocated to using organizations in performing maintenance work within their scope.

d. This first edition is being published in advance of complete technical review of all concerned. Any errors or omissions will be brought to the attention of Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM-Pub.

2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which have been restricted to depot shops and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts

listed in the appropriate columns of the current ORD 8 supply catalog pertaining to the vehicles incorporating this matériel. Instructions for depot maintenance are to be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Supply of parts listed in the depot guide column of ORD 8 supply catalogs will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization. Those operations which can be performed as "emergency field maintenance" are specifically covered as such in this manual.

3. Forms, Records, and Reports

a. GENERAL. Forms, records, and reports are designed to serve necessary and useful purposes. Responsibility for the proper execution of these forms rests upon commanding officers of all units maintaining this equipment. It is emphasized, however, that forms, records, and reports are merely aids. They are not a substitute for thorough practical work, physical inspection, and active supervision.

b. AUTHORIZED FORMS. The forms generally applicable to units maintaining this equipment are listed in the appendix. No forms other than those approved for the Department of the Army will be used. Pending availability of forms listed, old forms may be used. For current and complete listing of all forms, refer to current SR 310-20-6. Additional forms applicable to the using personnel are listed in the operator's manual. For instructions on use of these forms, refer to FM 9-10.

c. FIELD REPORT OF ACCIDENTS. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in the SR 385-10-40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to matériel occur.

d. REPORT OF UNSATISFACTORY EQUIPMENT OR MATERIALS. Any suggestions for improvement in design and maintenance of equipment, safety and efficiency of operation, or pertaining to the application of prescribed petroleum fuels, lubricants, and/or preserving materials, will be reported through technical channels as prescribed in SR 700-45-5 to the Chief of Ordnance, Washington 25, D. C., ATTN: ORDFM, using DA

AGO Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged in order that other organizations may benefit.

Note. Do not report all failures that occur. Report only REPEATED or RECURRENT failures or malfunctions which indicate unsatisfactory design or material. However, reports will always be made in the event that exceptionally costly equipment is involved. See also SR 700-45-5 and the printed instructions in DA AGO Form 468.

Section II. DESCRIPTION AND DATA

4. Cross-Drive Transmission

a. GENERAL. The CD-500 cross-drive transmission, is a combination transmission and steering unit designed for use with engines of 375 to 500 gross horsepower (figs. 1, 2, 3, and 4). The features of this transmission are hydraulic drive, planetary gearing, steering mechanism, braking mechanism,

and hydraulically operated clutches. The torque converter multiplies engine torque to provide an automatically variable output torque (par. 18e). The transmission consists of the assemblies grouped as indicated in *b* through *i* below (fig. 5).

Note. Complete functional descriptions with construction details are given in paragraphs 15 through 20.

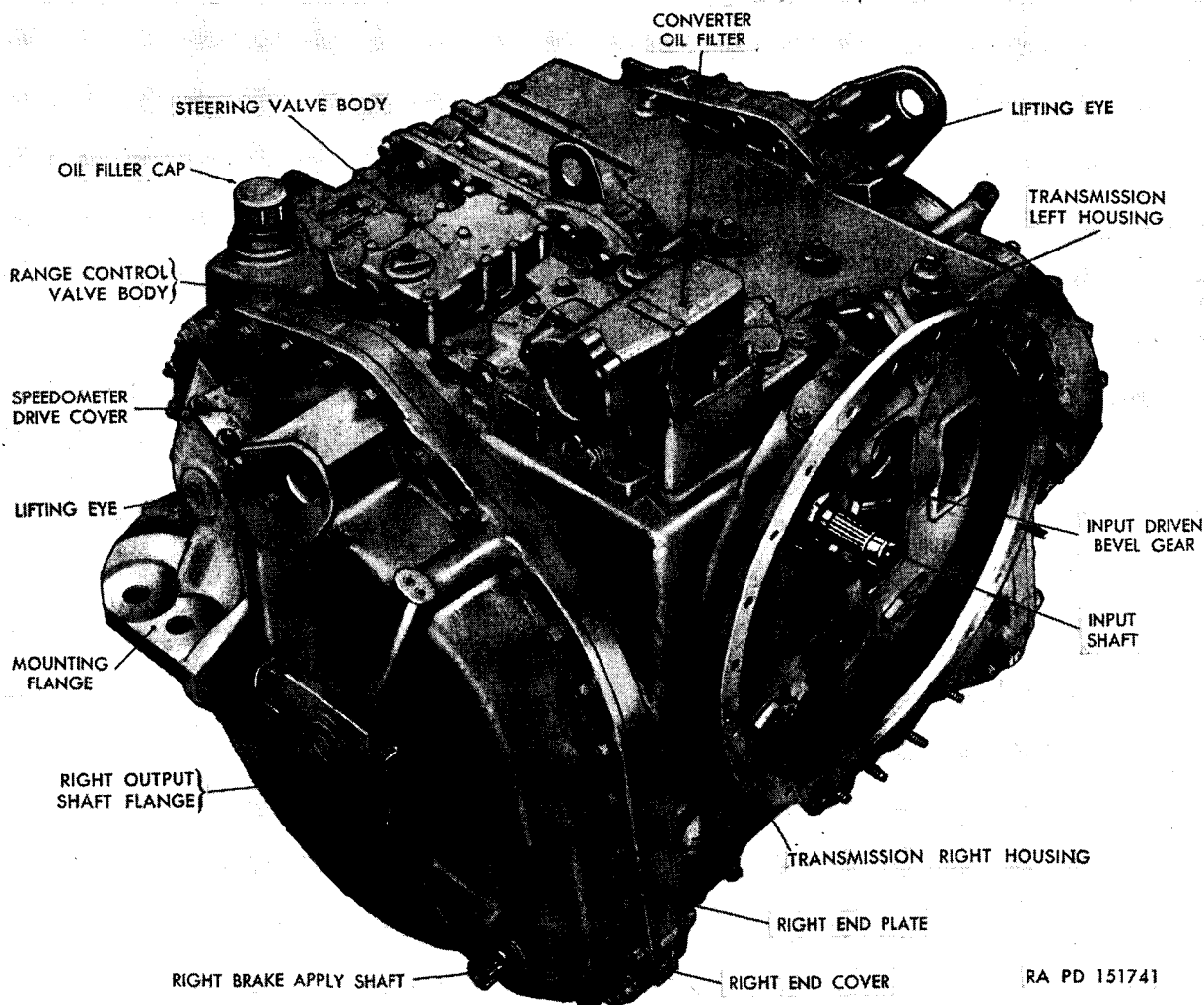


Figure 1. CD-500 cross-drive transmission, right front.

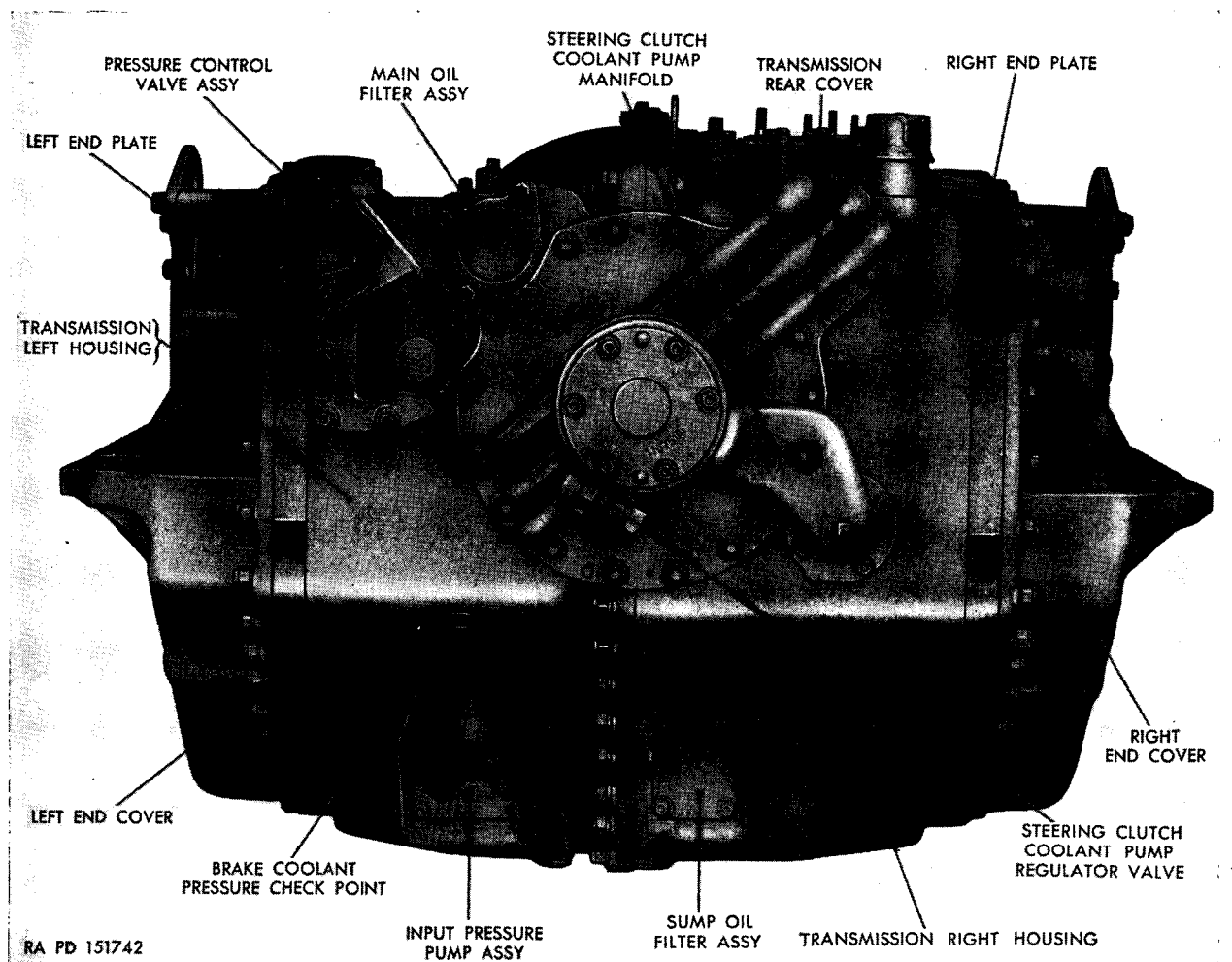


Figure 2. CD-500 cross-drive transmission, rear.

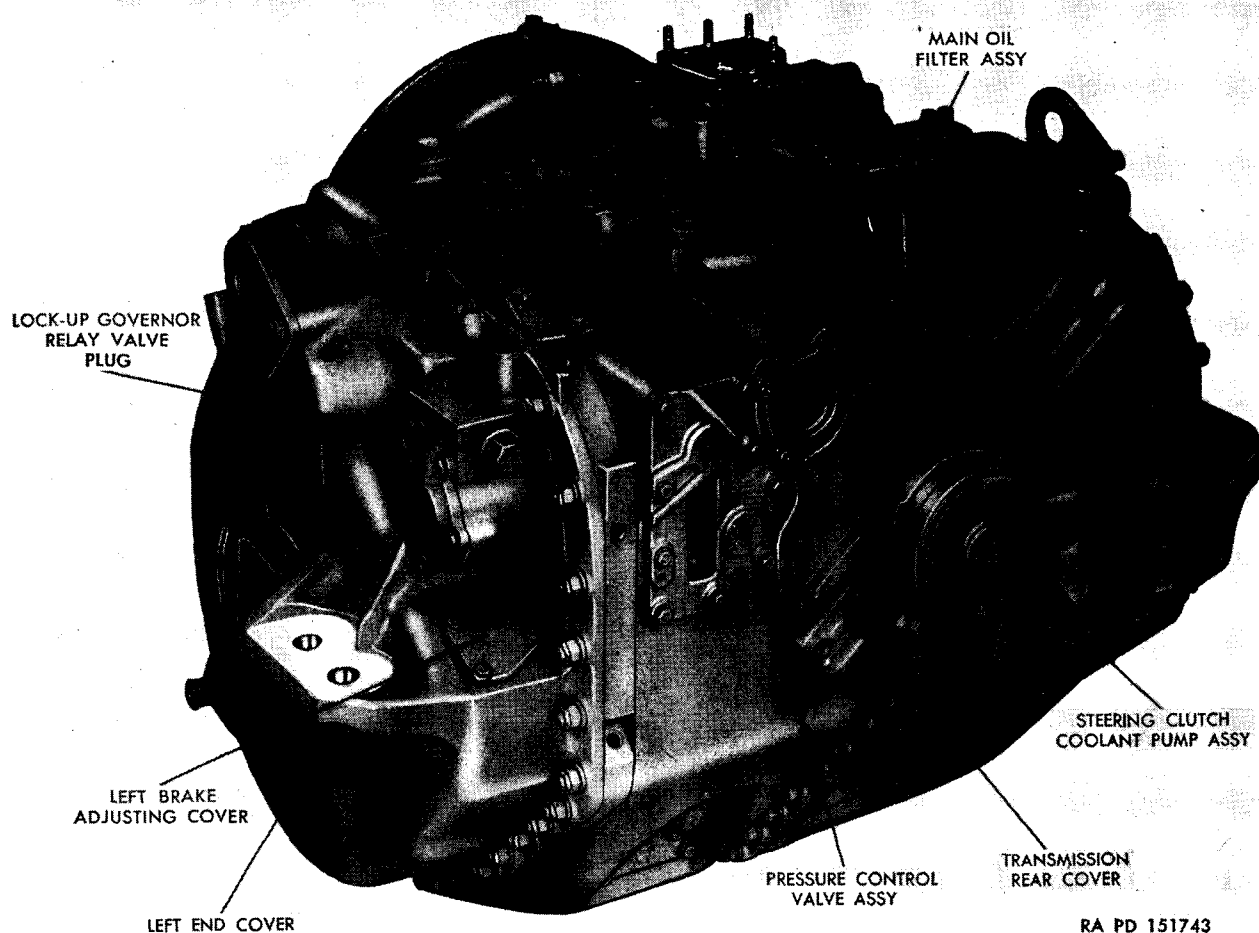
b. LEFT AND RIGHT HOUSING. The left and right housings (X and GG of fig. 14) are of cast aluminum and include the oil filler neck assembly, main oil filter assembly (M of fig. 14), pressure control valve assembly (Q of fig. 14), sump oil filter assembly (P of fig. 15), input pressure pump assembly (N of fig. 15), low-range accumulator (M of fig. 15), input scavenge and converter circulating pump (EE of fig. 14), and a rear cover assembly consisting of a cover, steering clutch coolant pump (H of fig. 14), regulator valve, and manifold.

c. INPUT DRIVE AND STEERING. This group includes the transmission input shaft (BB of fig. 14), fan drive spur gear, fan and pump pinion, fan drive gear and coupling, input-pressure-pump drive gear and shaft, input scavenge and converter circulating-pump drive gear, input bevel gear assembly (DD of fig. 14) consisting of the

input driving bevel gear and the input driven bevel gear, converter-drive gear (H of fig. 15), and the converter pump drive gear (G of fig. 15). The steering mechanism consists of a steering differential (N of fig. 14), controlled by two friction disk clutches, the left and right steering clutches (G and K of fig. 14). This design makes a separately controlled differential unnecessary.

d. CONVERTER. The CD-500 transmission has a polyphase, four element hydraulic torque converter (Y of fig. 14), incorporating a single disk lock-up clutch assembly (T of fig. 14). The converter consists of a turbine assembly, pump assembly, and the first and second stator assemblies.

e. END PLATES. The right end plate (HH of fig. 14) includes the low-, high-, and reverse-range clutch (D, L, and J of fig. 14), the low-range planetary assembly (C of fig. 14), the



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• Figure 3. CD-500 cross-drive transmission, left rear.

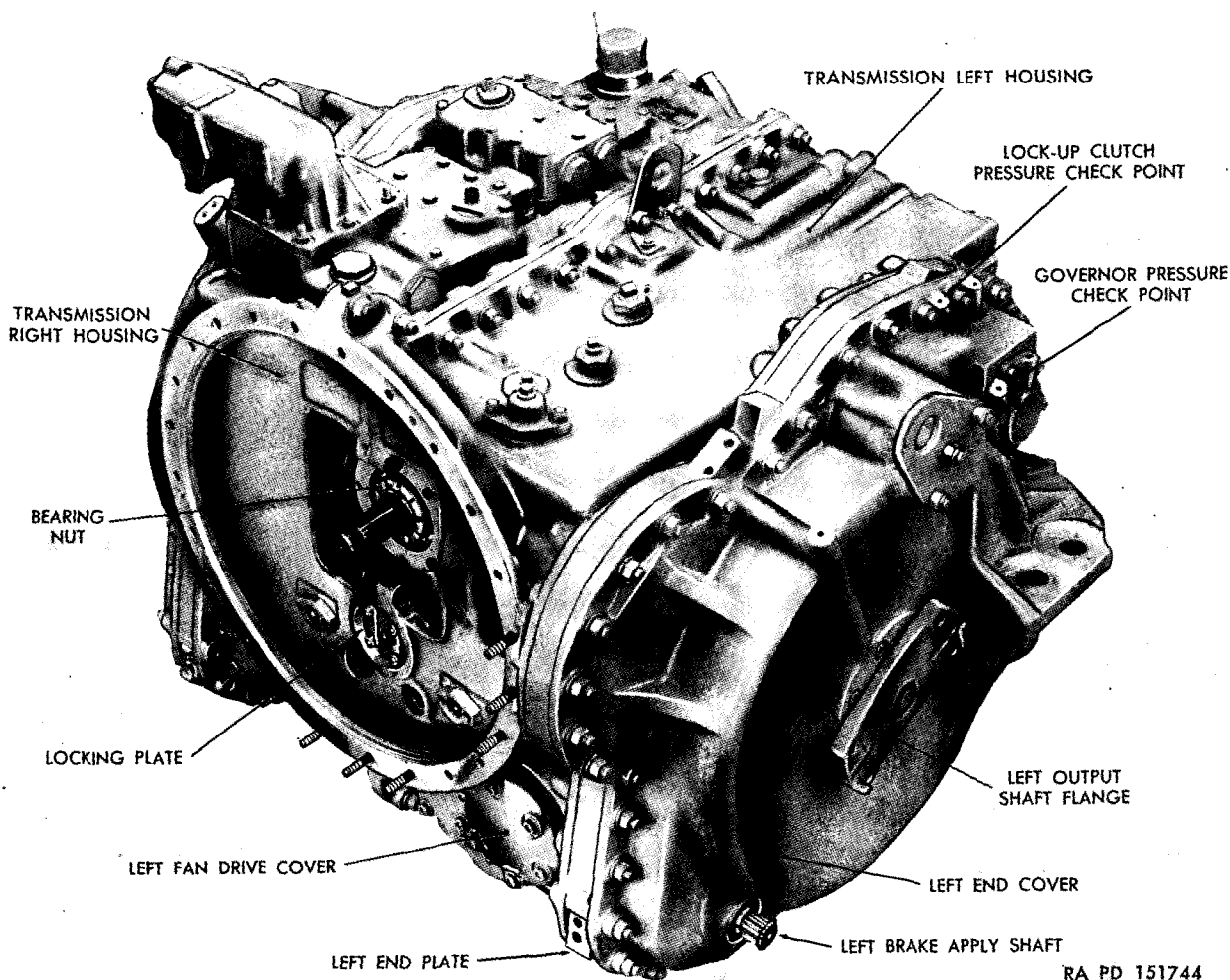
reverse-range planetary assembly (F of fig. 14), the right-brake-apply mechanism; the right-brake adjustment assembly, the right brake assembly (A of fig. 14), and the output sump pump (E of fig. 14). The left end plate (W of fig. 14) consists of the left-brake apply mechanism (U of fig. 14), left brake assembly, the left-brake adjustment assembly, and the output brake and pressure pump (R of fig. 14).

f. FINAL DRIVE AND BRAKES. The output planetary and the flange assembly make up the final drive which delivers torque at both ends of the transmission. Engine power is transmitted to the final drive through the torque converter and the planetary gearing. The braking mechanism uses a wet, friction disk brake on each output member. The brakes are mechanically operated by a single brake pedal in the driver's compartment.

g. END COVERS. The right end cover (MM of fig. 14) contains the right-output planetary assembly (B of fig. 14), the right steering-output pinion gear, the right steering-output gear and output sun gear assembly (KK of fig. 14), and the right-output flange assembly. The left end cover (V of fig. 14) includes the governor and relay valve assembly (S of fig. 14), the left-output planetary assembly, the left steering-output gear, the left steering-output pinion gear, the left output sun gear, and the left-output flange assembly.

h. CONTROL ASSEMBLIES (fig. 18). This group includes the range-control valve body and the steering valve body. A combination of range selection and steering is made by the use of controls in the driver's compartment.

i. PUMPS. The CD-500 transmission has six pumps. They are the input-scavenge and converter circulating pump (EE of fig. 14), steering-



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Figure 4. CD-500 cross-drive transmission, left front.

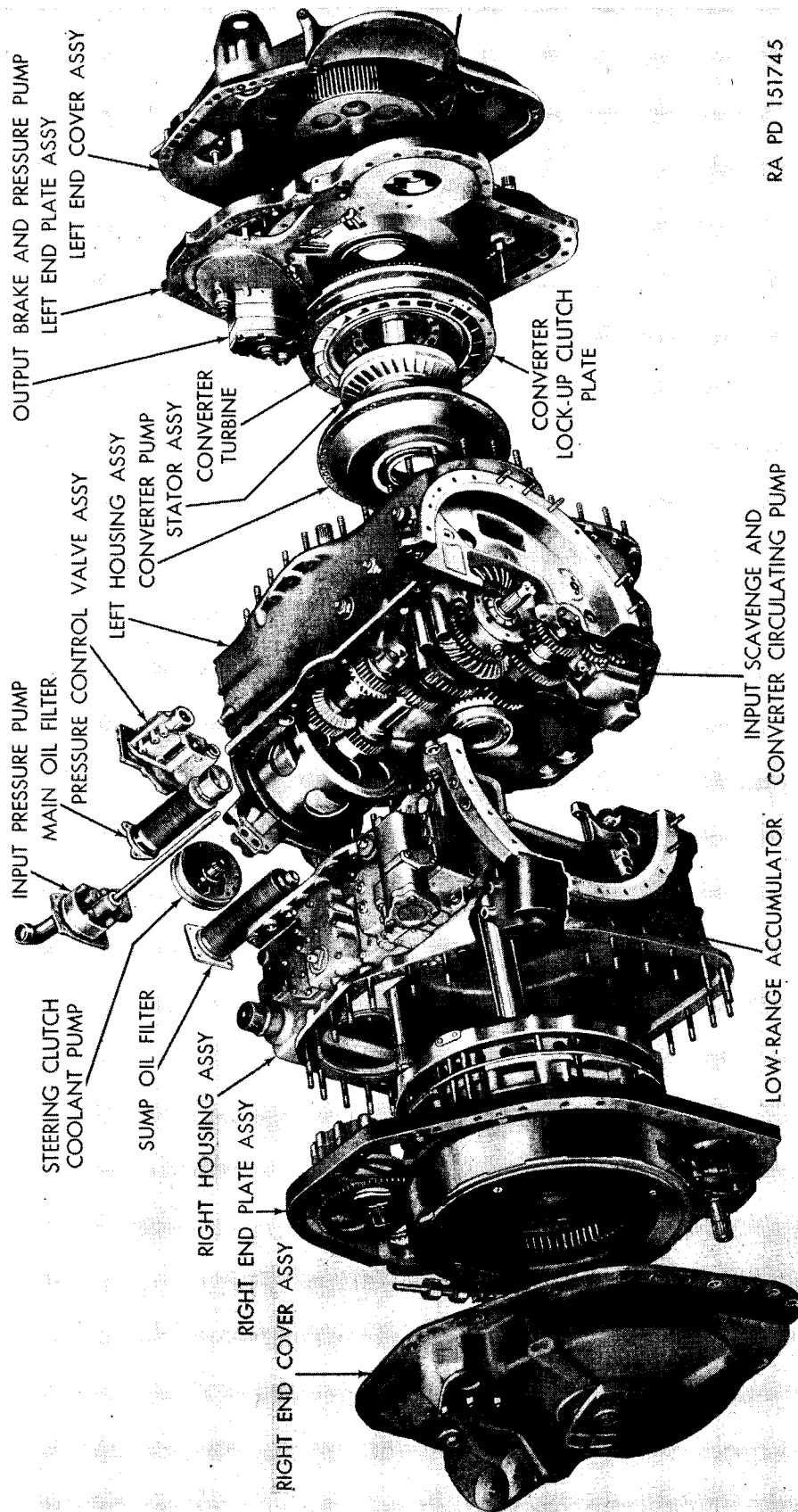
clutch coolant pump (H of fig. 14), output-sump pump (E of fig. 14), input-pressure pump (N of fig. 15), steering-overspeed limit pump (E of fig. 15), and output-brake-and-pressure pump (R of fig. 14).

5. Hydraulic and Lubrication Systems

a. GENERAL. The hydraulic and lubrication systems of the CD-500-3 and -4 cross-drive transmissions perform four functions: (1) as the apply force for the control clutches; (2) as the driving medium in the torque converter; (3) as a lubricant; and (4) as a cooling medium for the entire transmission, including the torque converter, clutches, and brakes (fig. 19). The systems use a single supply of oil. This oil is carried in that portion of the transmission housing which is called the reservoir. The oil capacity is 16 gallons to fill and 11 gallons to refill. Although

each system may employ the same units such as filters, pump, and coolers, all the units can be classified as belonging to the systems as listed in *b* through *g* below.

b. MAIN OIL SYSTEM. In the approximate order of flow sequence, the components of the main oil system are the sump, the sump oil filter, the input-scavenge pump (a component of the input scavenge and center pump), the output sump pump, the reservoir, the input-pressure pump, the main oil filter, the safety valve, and the main-pressure regulator valve. The main oil system provides the direct source of flow and pressure for the hydraulic controls system, the converter system, the converter lock-up clutch, and the brake lube signal valve. It is the indirect source of flow and pressure for the lubrication system. Detailed functional operation of the main oil system is given in paragraph 16.



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Figure 5. CD-500 cross-drive transmission, main subassemblies.

c. **HYDRAULIC CONTROLS SYSTEM.** This system is composed of the range-control valve, the low-range accumulator, the low-range clutch, the high-range clutch, the reverse-range clutch, the right- and left-steering valves and clutches, and the necessary connecting passages. The functions of range selection and steering are performed by this system. It receives its flow and pressure from the main oil system (par. 16).

d. **CONVERTER SYSTEM.** In the approximate order of flow sequence, the components of the converter system are the converter, the converter pump (a component of the input scavenge and converter pump), the converter check valve, the converter oil filter, the converter cooler by-pass valve, and the converter pressure regulator valve. This system regulates converter charging pressure and provides a cooling flow of oil through the converter. It receives its oil from the main oil system through the main pressure regulator valve (par. 16).

e. **LUBRICATION SYSTEM.** This system consists of the lube pressure regulator valve and a complete system of passages to conduct oil to all points in the transmission where lubrication is required. Oil is fed from the lube system to the steering overspeed limit pump and the steering overspeed safety valve. Lubrication system pressure is applied, through an oil passage, to the head of the brake lube relay valve (par. 16).

f. **BRAKE COOLING SYSTEM.** This system is made up of the output brake and pressure pump, the brake lube signal valve, the brake lube relay valve, the brake lube control valve, the right- and left-brake lube valves, and the necessary connecting passages. This system provides a cooling flow of oil through the brake disks while the brakes are applied (par. 16).

g. **MINOR OIL SYSTEMS.** These systems include the converter lock-up clutch, the steering overspeed limit pump, and the steering clutch coolant pump. Refer to paragraph 16 for the operation and description of the minor oil systems.

h. **PRESSURES.** The designed oil pressures in the hydraulic and lubrication systems range from

30 to 150 psi. A table of transmission oil pressures is included in paragraph 21.

i. **OPERATION WARNING LIGHTS.**

- (1) The low-lubricating oil pressure warning light will come on if the lubrication system pressure drops below 10 psi. The designed lubricating oil pressure is 30 psi.
- (2) The low-converter-oil "IN" pressure and the high-converter-oil "IN" temperature warning light will come on if either the pressure drops below 60 psi or the temperature goes above 280° F. The designed converter-oil "IN" pressure is 80 psi and the designed converter-oil "IN" temperature is 275° F.

6. Differences Between Models

a. **GENERAL.** The -3 designation indicates the third model designed. It is for use in ordnance tanks. The -4 designation indicates the fourth model designed. It is used in ordnance cargo carriers. The basic difference between the two models is found in the converter drive and driven spur gears.

b. **INPUT POWER PATH.** The input-driving bevel gear is splined to the rear part of the transmission input shaft. This gear, off its left side, drives the input driven bevel gear to which is splined the converter-drive (spur) gear (H of fig. 15). In mesh with the converter-drive gear is the converter pump drive gear, which is bolted to the converter lock-up piston housing assembly. This assembly is bolted to the converter pump. Because of the gearing, the CD-500-3 converter pump turns 1.4 times engine speed. By changing the converter drive and pump drive spur gears, a 1.3 speed ratio is obtained for use in the CD-500-4. The gear sets are interchangeable in either model.

c. **SPEEDOMETER DRIVE.** The speedometer drive sending unit is incorporated in the CD-500-4 transmission, but not in the CD-500-3. The -4 is provided with a mechanical speedometer adapter which is connected by a cable to the speedometer on the instrument panel.

CHAPTER 2

PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

7. Parts, Tools, and Equipment

a. GENERAL. Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and/or rebuilding the matériel.

b. PARTS. Maintenance parts are listed in Department of the Army Supply Catalog ORD 8 SNL G-251 which is the authority for requisitioning replacements. Parts not listed in an ORD 8 catalog, but required by depot shops in rebuild operations may be requisitioned from the listing in the corresponding ORD 9 catalog and will be supplied if available.

c. COMMON TOOLS AND EQUIPMENT. Standard

and commonly used tools and equipment having general application to this matériel are authorized for issue by T/A and T/O & E.

8. Special Tools and Equipment

The special tools and equipment tabulated in table I are listed in Department of the Army Supply Catalog ORD 6 SNL G-27, Section I. This tabulation contains only those special tools and equipment necessary to perform the operations described in this manual, is included for information only, and is not to be used as a basis for requisitions.

Note. Special tool sets in ORD 6 SNL G-27, Section I, in addition to special tools, also contain standard and commonly used tools and equipment specifically applicable to this matériel.

Table I. Special Tools and Equipment for Field and Depot Maintenance

Item	Identifying number	References		Use
		Fig.	Par.	
ADAPTER.....	41-A-18-380.....	6, 336.....	60c, 63c.....	Used with slide hammer remover 41-R-2373-216 to remove the oil pressure relief valve assembly GM 6760374.
ADAPTER.....	41-A-18-385.....	6, 338.....	60c, 63c.....	Used with slide hammer remover 41-R-2373-216 to remove the oil pressure accumulator jumper tube GM6762674.
ADAPTER.....	41-A-18-360.....	6, 235, 242, 256.....	56c(3), 56e(2), 56i(4).	Used with slide hammer remover 41-R-2373-216 to remove the fan and pump shaft GM6760264 and the pump-drive-gear and bearing spindle assembly GM6765015.
ARBOR.....	41-A-339-24.....	12, 74, 75, 76, 171, 184.	23g(7), 40a(1), 40a(2), 43a(2), 43a(4), 89e(4).	Used to replace the stators on the converter ground sleeve GM 6763926.
COUNTERBORE..	B7083790.....	12.....		Used in removing rosan insert GM 6765290 to counterbore $\frac{1}{2}$ deep, thereby breaking lock ring.
GAGE.....	45-G-438-500.....	11, 396.....	90a(3).....	Used to check transmission oil pressure.

Item	Identifying number	References		Use
		Fig.	Par.	
HANDLE-----	41-H-1396-505	7, 163, 230-----	38g (1), 54b (2), 54c(2).	Used with replacer 41-R-2392-72 to replace oil seal GM6700686 on control valve body GM6765560. Used with replacer 41-R-2379-960 to replace bearing GM6702341 in the two inner brake shaft brackets GM6764581 and GM6764582.
HANDLE-----	41-H-1396-509 (A7083701).	7, 168-----	38g(3)-----	Used with replacer 41-R-2381-320 to replace bearing GM444916 in brackets GM6764588 and GM-6764585.
HANDLE-----	41-H-1396-510	8, 141, 142, 261, 262, 280, 281.	34b (4), 34b (5), 58b(5), 58e(1), 58e(2).	Used with replacer 41-R-2387-750 to replace output support bushing GM6704107. Used with replacer 41-R-2398-950 to replace oil seal GM6704106. Used with replacer 41-R-2381-875 to replace needle bearing GM6704022 in steering differential and spindle assembly. Used with replacer 41-R-2392-465 to replace bearing GM903306 in steering differential and spindle assembly. Used with replacer 41-R-2382-550 to replace bearing GM903207 in fan and pump drive. Used with replacer 41-R-2373-862 to replace bearing GM903206 in fan and pump drive.
PLIERS-----	41-P-1992-27	9, 164-----	38g (2), 56i (3), 59c(2).	Used to remove snap ring GM6764019 from input pressure pump. Used to remove snap ring GM6762065 from brake assemblies.
PLIERS-----	41-P-1992-35	9, 228-----	52a(2)-----	Used to remove or replace snap ring GM6703424 on control valve body GM6765560.
PLIERS-----	41-P-1992-34	9-----	56e(2)-----	Used to remove snap ring GM6764531 from input pressure pump.
PLIERS-----	41-P-1992-36	9, 47, 112, 313-----	23c, 24c, 58k(1)---	Used to remove snap ring GM6760199 and to compress snap ring GM6760132 on steering clutch package. Used to remove the retainer GM6704414 from fan drive gear.
PLIERS-----	C7083704-----	9, 72-----	23g(5)-----	Used to remove snap ring GM6763940 in hydraulic torque converter.
PLUG, holding-----	41-P-2107-200 (A7083776)	12, 67-----	23g(1) 89e(8)-----	Used by attaching through hole in web of GM6764501 or GM6764502 gear in hydraulic torque converter.

Item	Identifying number	References		Use
		Fig.	Par.	
REMOVER-----	41-R-2373-216--	6, 235, 242, 256, 336, 338.	56c(4), 56e(2), 56i(4), 60c.	Used with adapter 41-A-18-380 to remove the oil pressure relief valve assembly GM6760374. Used with adapter A7082774 to remove the oil pressure accumulator jumper tube GM6762674. Used with adapter 41-A-18-360 to remove the fan and pump shaft GM6760264 and the fan drive spindle GM6765015.
REMOVER and REPLACER	41-R-2373-862--	8, 280-----	8e(1), 58e(2)-----	Used with handle 41-H-1396-510 to replace bearing GM903206 in fan and pump drive.
REPLACER-----	41-R-2392-465--	8, 262-----	58b(5)-----	Used with handle 41-H-1396-510 to replace bearing GM903306 in steering differential and spindle assembly.
REPLACER-----	41-R-2381-320--	7, 168-----	38g(3)-----	Used with handle A7083701 to replace bearing GM444916 in brackets GM6764588 and GM6764585.
REPLACER-----	41-R-2382-550--	8, 281-----	58e(2)-----	Used with handle 41-H-1396-510 to replace bearing GM903207 in fan and pump drive.
REPLACER-----	41-R-2387-750--	8, 142-----	34b(5)-----	Used with handle 41-H-1396-510 to replace output support bushing GM6704107.
REPLACER-----	41-R-2392-72---	7, 230-----	54b(2), 54c(2)-----	Used with handle 41-H-1396-505 to replace oil seal GM6700686 on control valve body GM6765560.
REPLACER-----	41-R-2379-960--	7, 163-----	38g(1)-----	Used with handle 41-H-1396-505 to replace bearing GM6702341 in the two inner brake shaft brackets GM6764581 and GM6764582.
REPLACER-----	41-R-2381-875--	8, 261-----	58b(5)-----	Used with handle 41-H-1396-510 to replace needle bearing GM6704022 in steering differential and spindle assembly.
REPLACER-----	41-R-2398-950--	8, 141-----	34b(4)-----	Used with handle 41-H-1396-510 to replace oil seal GM6704106.
RETAINER-----	41-R-2446-200 (C7083772)	11, 84, 90, 383-----	23i(3), 36a, 38e(1)-----	Used when removing and replacing brake apply ring in order to retain parts as a unit.
SCREW, puller----	41-S-1044-125-	12, 60, 64, 80, 95, 104.	23e(4), 23f, 23h, 23i(14), 23k.	Use (3) with sling 41-S-3832-165 to remove end covers. Use (3) to pull left end plate from housing. Lift with sling 41-S-3830-550. Use (3) to pull right end plate from housing. Lift with sling 41-S-3830-550. Use (3) to split housings and lift with sling C7083778.
SLING, lifting-----	C7083778-----	11, 97, 98, 105, 245-	23j(1), 23k, 56f(1), 89c(1).	Used with (3) puller screws 41-S-1044-125 to part housings.

Item	Identifying number	References		Use
		Fig.	Par.	
SLING, lifting-----	41-S-3832-165--	11, 38-----	22b(1), 23a-----	Used to lift transmission. Used with (3) puller screws 41-S-1044-125 to lift end covers.
SLING, lifting-----	41-S-3830-550--	11, 64, 95, 96, 392--	23f, 23i(14), 89c(2), 89f(1).	Used with (3) puller screws 41-S-I 1044-125 to lift the end plates.
THIMBLE-----	41-T-1640-----	12, 386, 394-----	89c(17), 89f(5)-----	Used to slide end cover over brake apply shaft GM6763649.
TOOL-----	41-T-3092-350--	9-----	-----	Used for removing inserts GM6763131, GM6765363, GM6763110, GM6763263, GM6764509, GM6764938, GM6763109, and GM6761319.
TOOL-----	41-T-3092-355--	9-----	-----	Used for removing insert GM6763915.
TOOL-----	B7083787-----	-----	-----	Used for difficult removing of heli-coils in housings.
TOOL-----	A7751060-----	-----	-----	Used to install insert GM6763131.
TOOL-----	41-T-3217-760--	9-----	-----	Used to install inserts GM6763263, GM6763110, and GM6765363.
TOOL-----	A7751064-----	-----	-----	Used to install insert GM6763109.
TOOL-----	A7083736-----	-----	-----	Used to install insert GM6763915.
TOOL-----	A7083739-----	-----	-----	Used to install insert GM6761319.
TOOL-----	A7083784-----	-----	-----	Used to install heli-coils in housings.
WRENCH-----	A7083737-----	-----	-----	Used to turn in new rosan insert GM6765290.
WRENCH-----	41-W-869-375 (B7083775)	12, 67-----	23g(2), 89e(8)-----	Used to remove nut GM6764543 on hydraulic torque converter.
WRENCH-----	41-W-544-100--	10, 286-----	58f(5)-----	Used to remove input shaft nut GM6700558.
WRENCH-----	41-W-3736-280--	12, 278-----	58d(1), 58d(5), 62d(1), 62d(5).	Used to remove nut GM6760192.
WRENCH-----	41-W-640-285--	10, 251-----	56i(1), 59c(1)-----	Used to remove nut GM6763603.
WRENCH-----	41-W-640-310--	10, 260-----	58b(2), 58b(13)-----	Used to remove spanner nut GM127714.
WRENCH-----	41-W-640-315--	10, 272-----	58c(4), 58c(8)-----	Used to remove spanner nut GM127716 on left steering shaft.
WRENCH-----	41-W-640-320--	10, 305-----	58g(1), 58g(4)-----	Used to remove converter output shaft lock nut GM6760027.
WRENCH-----	41-W-640-305--	10, 266-----	58c(1), 58c(11)-----	Used to remove spanner nut GM6760342 on right steering shaft.
WRENCH-----	41-W-869-385 (B7083777)	12, 284-----	58f(3), 58f(18)-----	Used to remove converter output drive pinion nut GM6765682.
WRENCH, torque-----	41-W-3634-----	68-----	23g(2), 89e(8)-----	Used to torque nut GM6764543 on the hydraulic torque converter to 300 lb-ft. Used on the converter output drive pinion nut GM6765682. (Set to 200 lb-ft.).

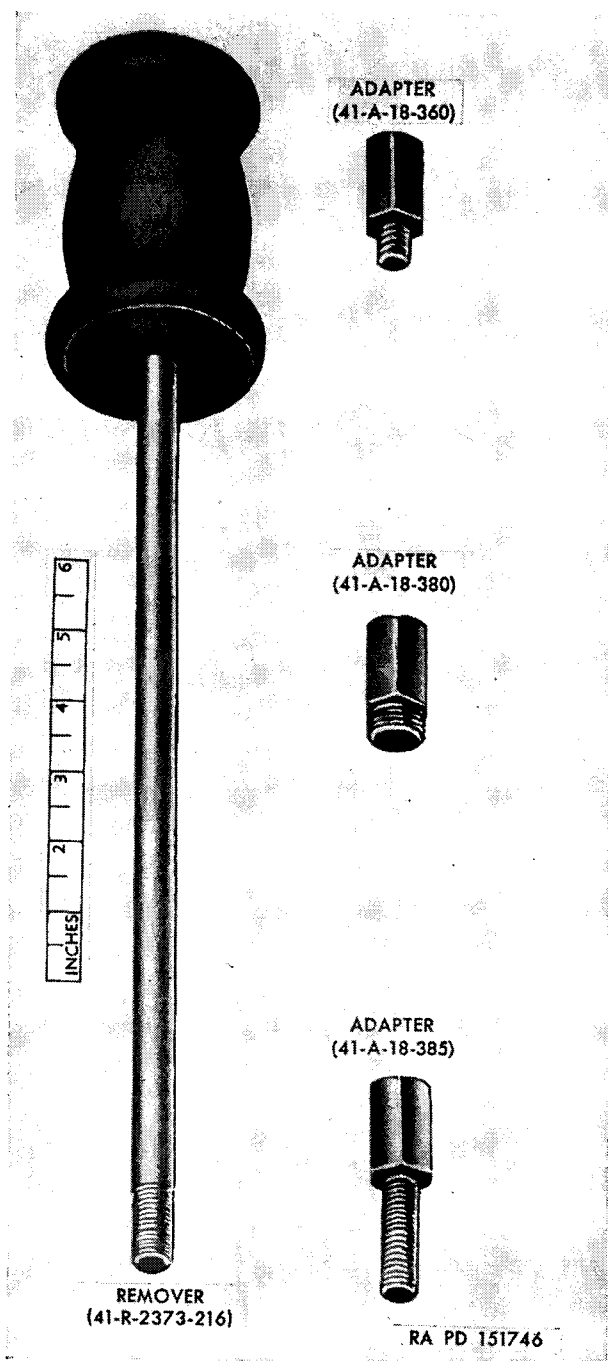


Figure 6. Special tools and equipment.

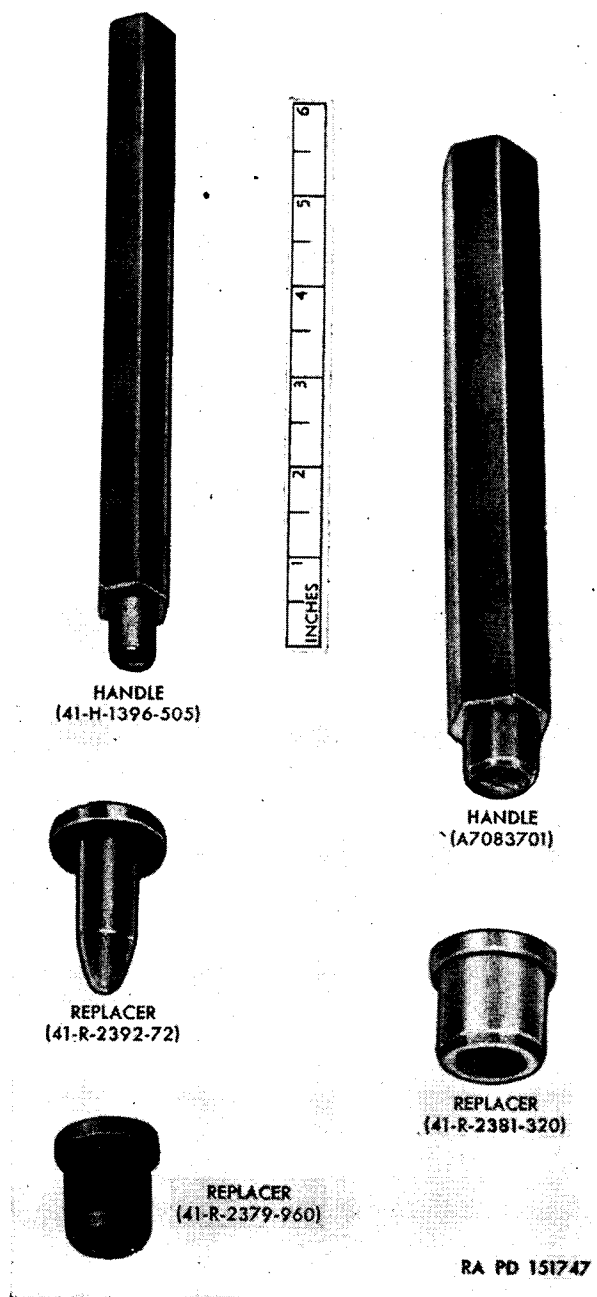


Figure 7. Special tools and equipment.

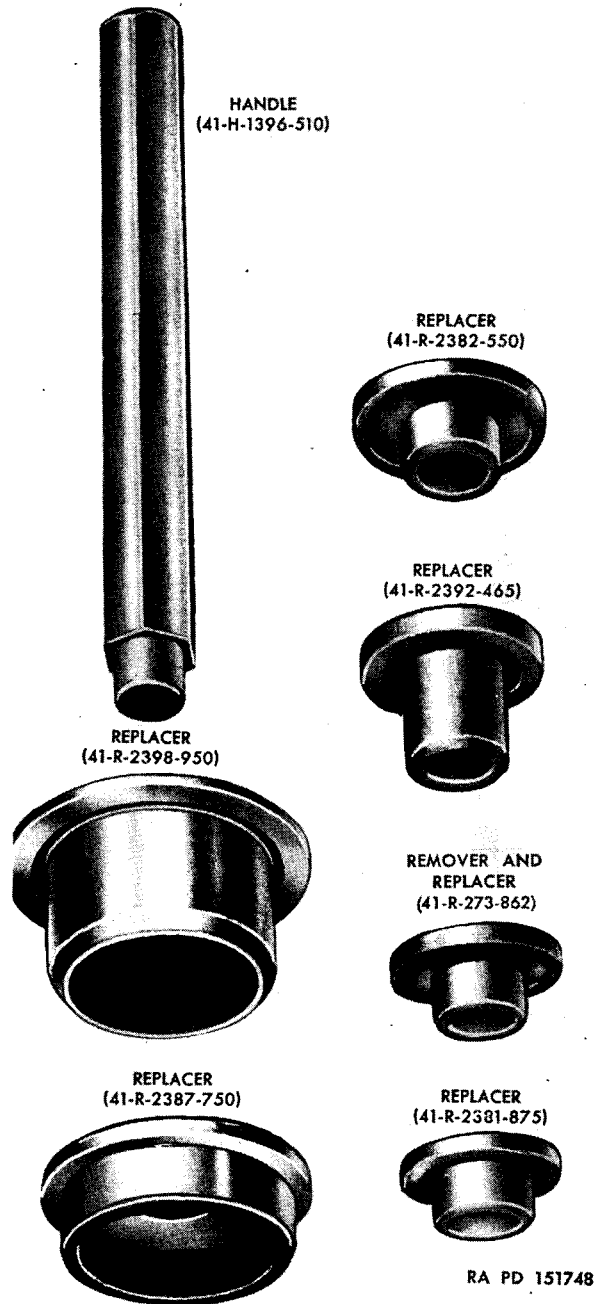


Figure 8. Special tools and equipment.

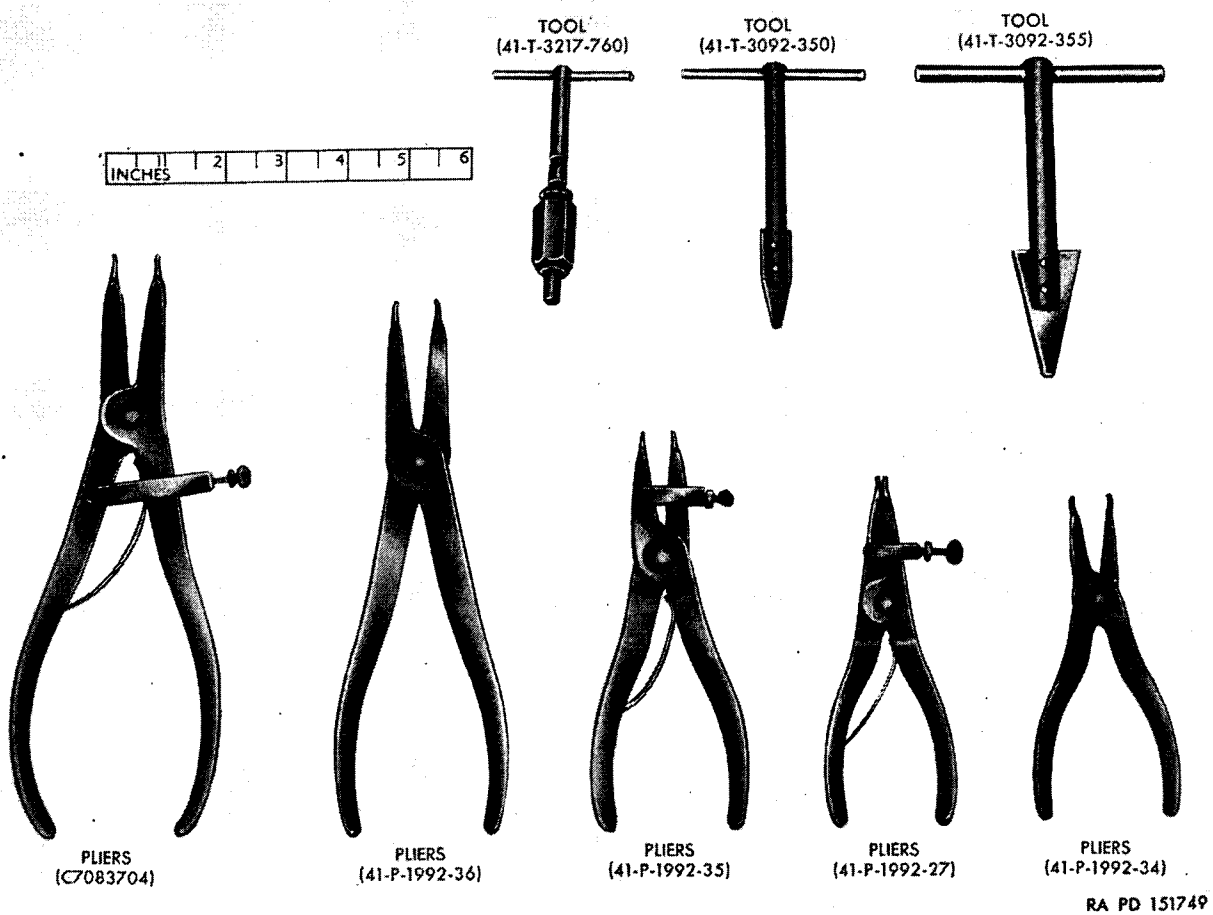


Figure 9. Special tools and equipment.

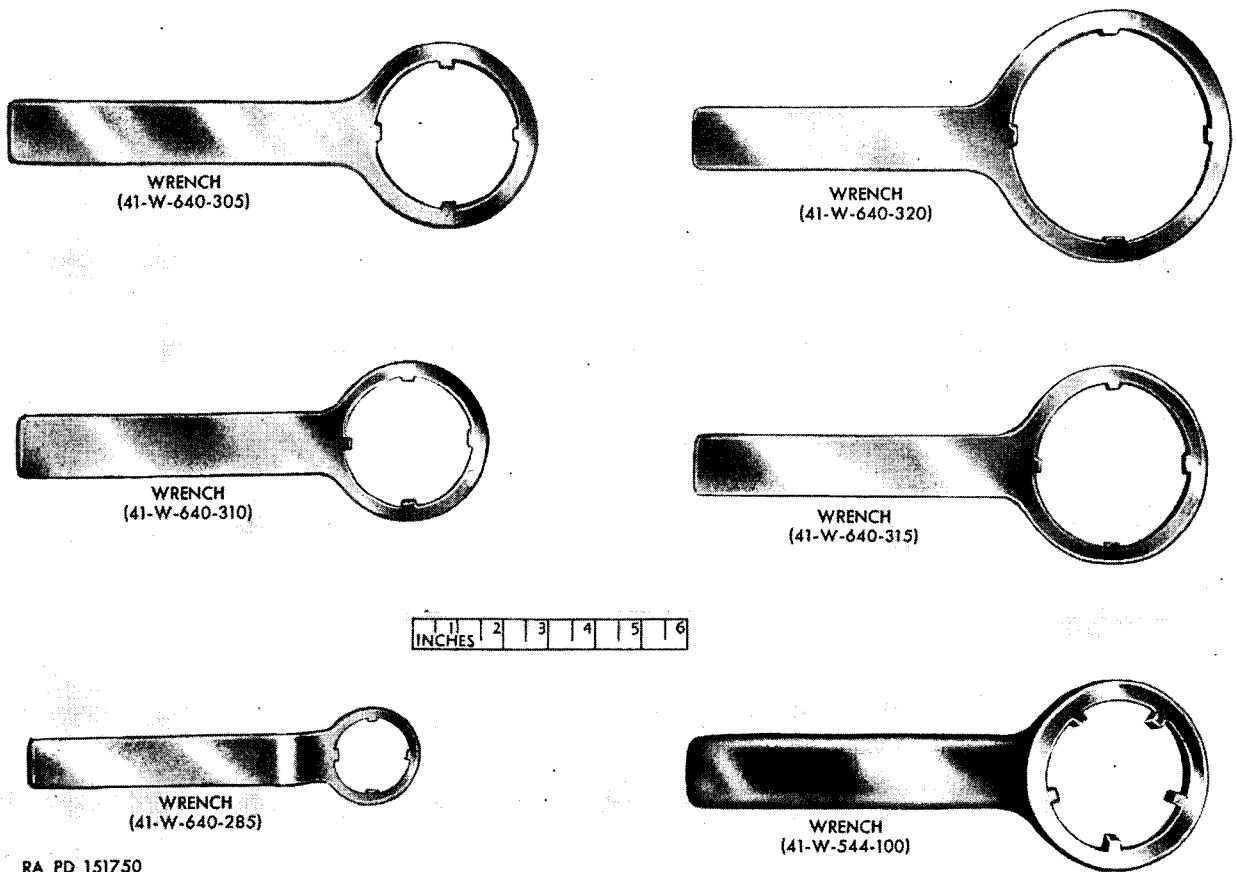


Figure 10. Special tools and equipment.

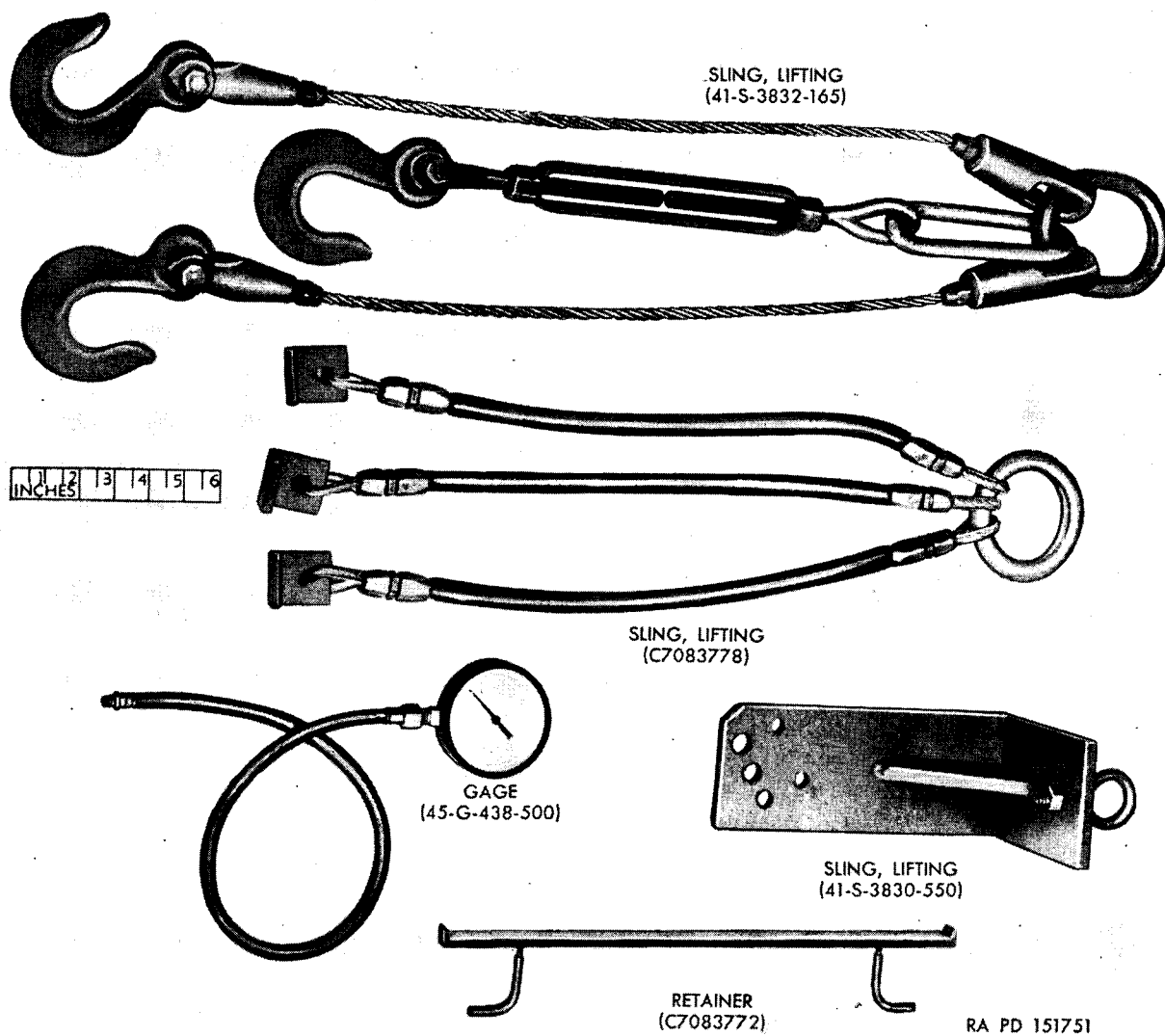
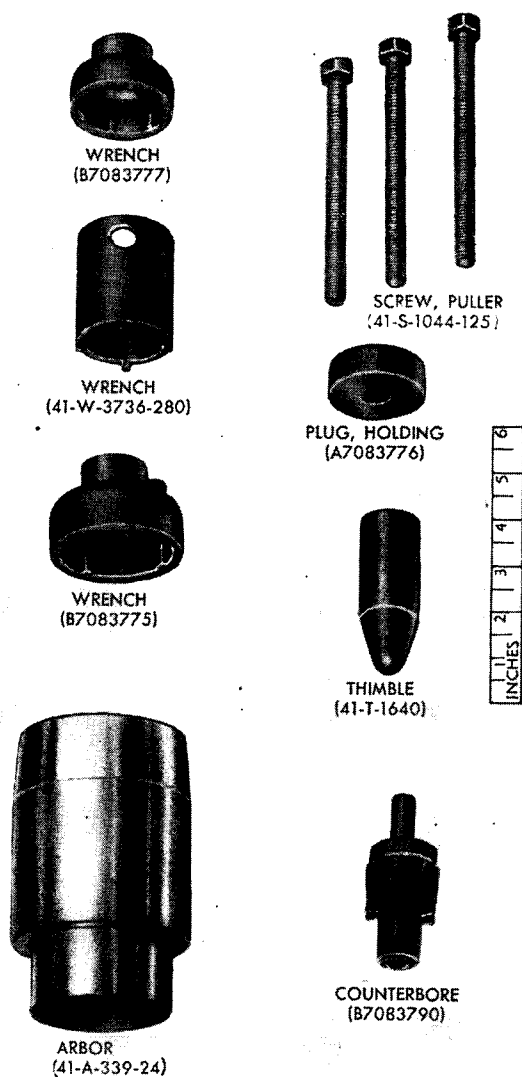


Figure 11. Special tools and equipment.



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Figure 12. Special tools and equipment.

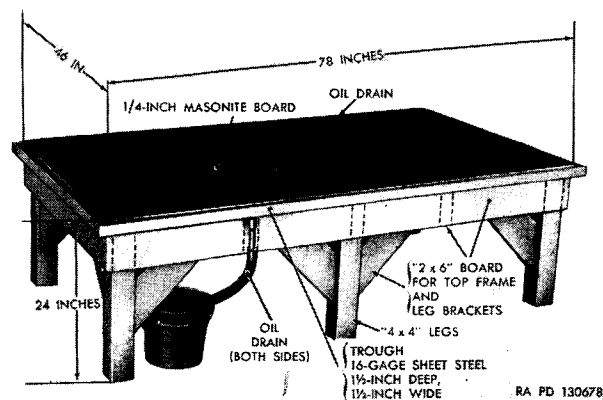


Figure 13. Assembly and disassembly table.

9. Improvised Tools

Information furnished in table II is intended for depots, arsenals, and all other corresponding organizations performing major overhaul work on the CD-500 cross-drive transmissions. The chief value of these tools is to maintenance organizations engaged in rebuilding a large number of identical components. These tools are not available for issue; the list is included for information only.

Table II. Improvised Tools for Field and Depot Maintenance

Item	References		Use
	Fig.	Par.	
BLOCK, wood, 2 x 4 x 6 in.	41	23a	Used to level and block up transmission for disassembly.
BLOCK, wood, 2 x 4 x 12 in.	41, 59	23a	Used to level and block up transmission for disassembly.
TABLE, assembly and disassembly.	13	23a	Used for disassembly and assembly of cross-drive transmission, model CD-500-3 and -4.

CHAPTER 3

INSPECTION AND TROUBLE SHOOTING

Note. Information in this chapter is for the use of ordnance maintenance personnel in conjunction with and as a supplement to the trouble shooting section in the pertinent operator's manual. It provides the continuation of instructions where a remedy in the operator's manual refers to ordnance maintenance personnel for corrective action.

Section I. GENERAL

10. Purpose

Operation of a deadlined vehicle without a preliminary examination can cause further damage to a disabled component and possible injury to personnel. By careful inspection and trouble shooting such damage and injury can be avoided and, in addition, the causes of faulty operation of a vehicle or component can often be determined without extensive disassembly.

11. General Instructions and Procedures

This chapter contains inspection and trouble shooting procedures to be performed while a disabled component is still mounted in the vehicle and after it has been removed.

a. The inspections made while the component is mounted in the vehicle are for the most part visual and are to be performed before attempting to operate the vehicle. The object of these inspections is to avoid possible damage or injury and also to determine the condition of and, when possible, what is wrong with the defective component.

b. The trouble shooting performed while the component is mounted in the vehicle is that which is beyond the normal scope of using organization. Check the trouble shooting section of TM 9-730, or other pertinent operator's manuals, to be sure the trouble is not a defect normally corrected by the using organization, then proceed as outlined in this chapter. These trouble shooting operations are used to determine if the fault can be remedied without removing the component from the vehicle and also, when subsequent removal is necessary, to indicate when repair can be made without complete disassembly of the component. If removal from the vehicle is necessary, refer to pertinent operator's manuals for necessary instructions.

c. Inspection after the component is removed from the vehicle is performed to verify the diagnosis made when the component was in the vehicle, to uncover further defects, or to determine faults if the component alone is received by the ordnance establishment. This inspection is particularly important in the last case because it is often the only means of determining the trouble without completely disassembling the component.

Section II. CROSS-DRIVE TRANSMISSION

12. Operating Characteristics

a. GENERAL.

- (1) Refer to paragraphs 15 through 20 for detailed functional descriptions of the cross-drive transmission and its operations under various conditions. *Intelligent interpretation of test readings can be made only when the servicing personnel understand how this transmission functions and its operating characteristics.*
- (2) The operating characteristics are described here to enable the mechanic to distinguish between normal and abnormal functioning of the cross-drive transmission.

b. TORQUE CHARACTERISTICS.

- (1) The hydraulic power path through the converter and four planetary units provides an instant change in output torque in accordance with the constantly varying demands at the driving sprockets in cross-country operation. Unlike the step-gear-type transmission, considering any particular selective gear ratio for which there is only one point in its power speed range that provides for maximum efficiency, maximum torque, or maximum horsepower, the CD-500 cross-drive transmission automatically varies the torque to the demand without shifting gears.

- (2) Because of the inherent characteristics of the torque converter, the vehicle will start smoothly when put in motion. There will be no jerky movements as acceleration occurs (par. 18*e*).

c. SPEED RANGES. There are two forward speed ranges (low and high) and one in reverse. The vehicle will start forward from a standing position in high range, unless it is standing on an incline, rough terrain, or is bogged down. The shift lever in the driver's compartment should always be left in neutral when the vehicle is left standing.

d. STEERING. Due to the design of the steering differential in the CD-500 transmission, steering is accomplished by reducing the speed of one output member while increasing proportionately the speed of the opposite output member (par. 19*b* and *e*).

13. Trouble Shooting Before Removal and During Operation in Vehicle

a. PRELIMINARY INSTRUCTIONS. The checks that can be made on the transmission installed in the vehicle are visual checks, such as oil leaks, oil level, temperature, oil pressures and brake operation. Paragraph 21*b* gives the oil pressure data and figure 37 shows the points where pressure tests are made. See paragraphs 90 through 92 for tests and adjustments of the transmission.

b. VEHICLE WILL STEER IN ONE DIRECTION ONLY. If both the steering linkage and brakes are properly adjusted and the steering valves are operating correctly, indications are that there is a leakage in (1) the steering clutch oil line, (2) the steering clutch piston seal, (3) the hook-type seal rings on the oil transfer sleeve, or (4) steering clutch failure. Remove the transmission for detailed inspection and repair (pars. 22 through 27).

c. VEHICLE WILL NOT STEER. If the control linkage and the steering valves in the steering valve body are operative, and if the right and left steering clutch pressures are within allowable range, and if both brakes are not locked, indications are that there is (1) a failure in the steering clutches, (2) a failure in the steering differential, or (3) a clogged steering clutch oil passage. Remove the transmission for detailed inspection and repair (pars. 22 through 27, and 60 through 63).

d. VEHICLE WILL NOT DRIVE IN LOW RANGE. If the control linkage and the range selector valve

are operative, and if the main and converter oil pressures are normal, and if both brakes are not locked, indications are that there is (1) a failure in the reverse-range clutch, (2) a failure in the high-range clutch, or (3) leakage in the low-range piston seal. Remove the transmission for detailed inspection and repair (pars. 22 and 23, and 48 through 51).

e. VEHICLE WILL NOT DRIVE IN HIGH RANGE. If the control linkage and the range selector valve are operative, and if the main and converter oil pressures are normal, and if both brakes are not locked, indications are that there is (1) a failure in the low-range clutch, (2) a failure in the reverse-range clutch, (3) a failure in the high-range piston, or (4) a leakage in the high-range clutch hook-type seal rings. Remove the transmission for detailed inspection and repair (pars. 22, 23, and 48 through 51).

f. VEHICLE WILL NOT DRIVE IN REVERSE RANGE. If the control linkage and the range selector valve are operative, and if the main and converter oil pressures are normal, and if both brakes are not locked, indications are that there is (1) a failure in the low-range clutch, (2) a failure in the high-range clutch, or (3) leakage in the reverse-range piston seal. Remove the transmission for detailed inspection and repair (pars. 22, 23, and 48 through 51).

g. VEHICLE CREEPS FORWARD IN NEUTRAL RANGE. If the control linkage is properly adjusted, indications are that there is (1) a failure in the low-range clutch or (2) a failure in the high-range clutch. Remove the transmission for detailed inspection and repair (pars. 22, 23, and 48 through 51).

h. VEHICLE CREEPS REVERSE IN NEUTRAL RANGE. If the control linkage is properly adjusted, indications are that the reverse-range clutch has failed. Remove the transmission for detailed inspection and repair (pars. 22, 23, and 48 through 51).

i. VEHICLE HAS STEERING DRAG. If the control linkage, brakes, and vehicle tracks are properly adjusted, check for a vehicle road wheel bearing failure. If there are no bearing failures, indications are that there is (1) a failure in the steering clutches or (2) a failure in the steering differential. Remove the transmission for detailed inspection and repair (pars. 22, 27, and 56 through 59).

j. CONVERTER OIL TEMPERATURE TOO HIGH. If the converter oil filter and coolers are not clogged, and if the cooling fan and thermostat are

operative, and if the engine shroud is not leaking, indications are that there is a failure in (1) the high-range clutch, (2) the reverse-range clutch, (3) the steering clutches, or (4) the converter. Remove the transmission for detailed inspection and repair (pars. 22 through 27, and 40 through 43).

Warning: When a new or rebuilt transmission has been installed in the vehicle after a transmission failure, the converter oil filter should be removed for inspection after approximately 200 miles of operation.

14. Trouble Shooting After Removal and During Operation On Stand

a. PRELIMINARY INSTRUCTION. All checks, tests, and diagnoses made while the transmission was operating in the vehicle (par. 13) can be repeated on the stand as a double check before disassembling the transmission.

b. TESTING. The checks and tests outlined in paragraphs 90 through 92 should be performed on all deadlined transmissions. These checks and tests will aid in determining or confirming the trouble.

CHAPTER 4

CROSS-DRIVE TRANSMISSION

Section I. DESCRIPTION AND DATA

15. Description

a. GENERAL. The CD-500 cross-drive transmission was designed for ease of operation. To make this possible, a hydraulic torque converter, planetary gear systems, for high, low, and reverse ranges, hydraulically operated clutches, steering differential, and a braking system were all incor-

porated in the transmission (figs. 14 through 17). The brakes are foot operated; the forward- and reverse-speed ranges and the steering are hydraulically controlled from the driver's compartment. How the transmission works, torque multiplication, and power paths are explained in paragraphs 16 through 20.

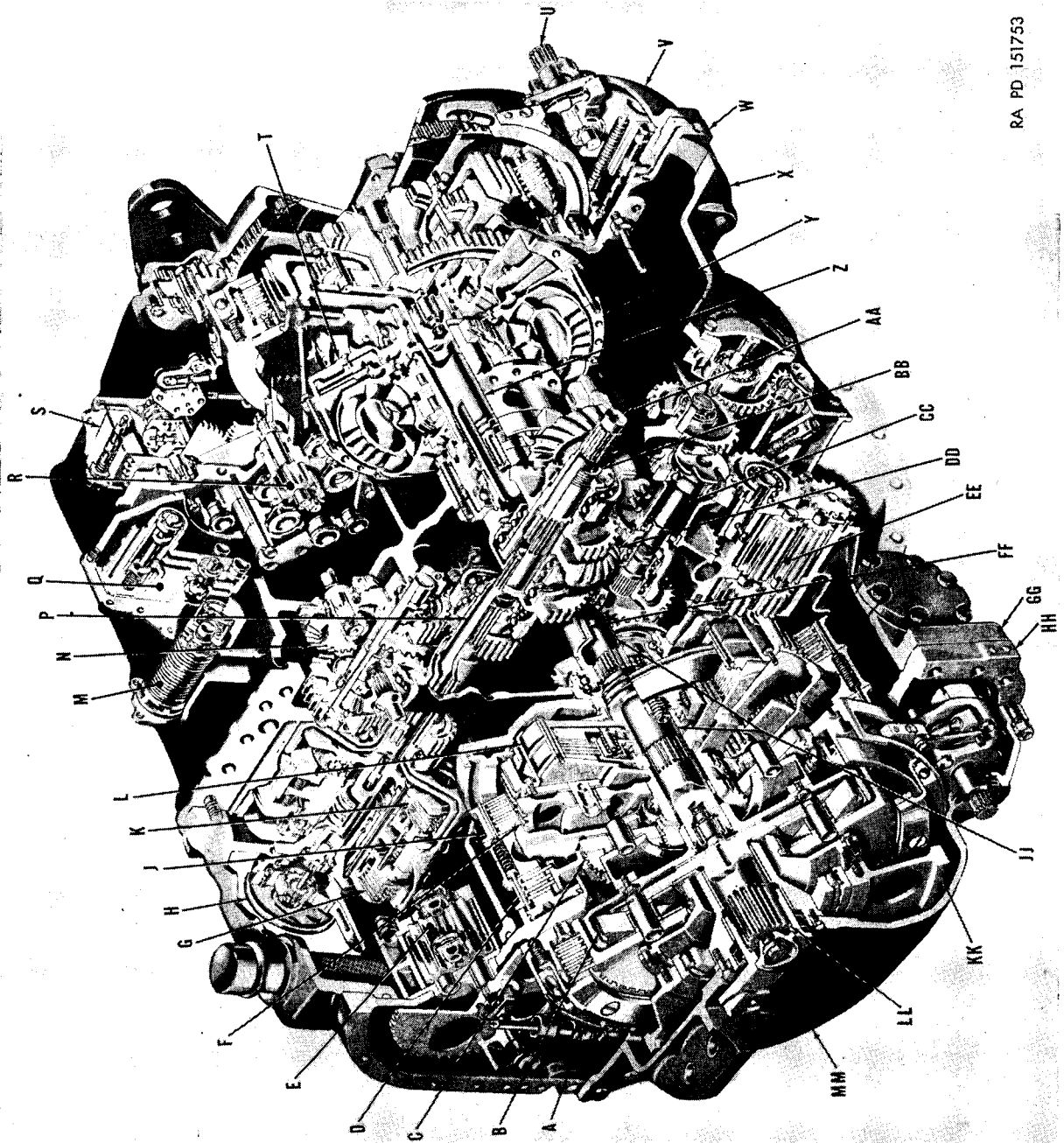
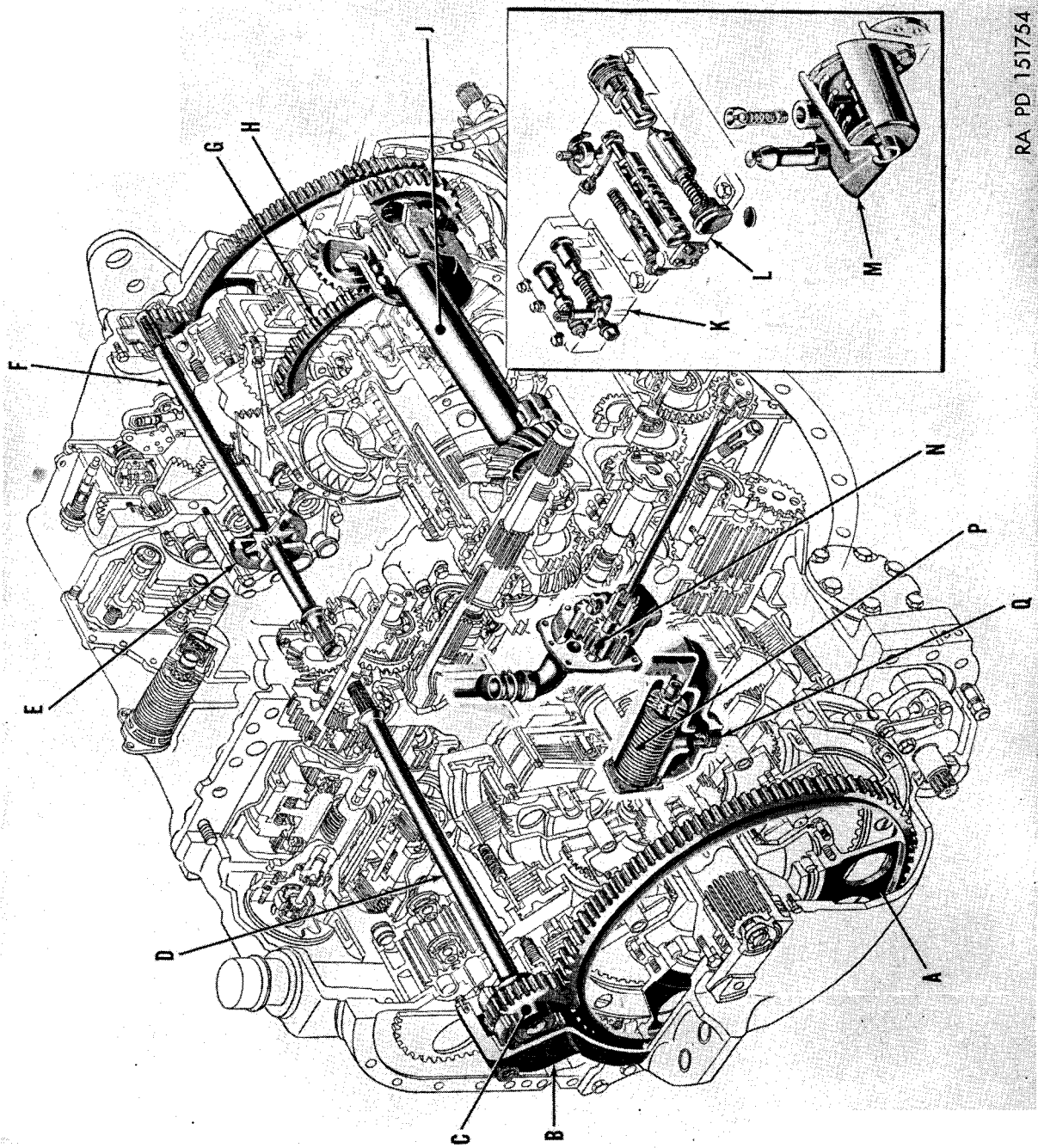


Figure 14. CD-500-3 and -4 cross-drive transmission—cutaway view.

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A—RIGHT BRAKE ASSEMBLY
 B—RIGHT OUTPUT PLANETARY ASSEMBLY
 C—LOW-RANGE PLANETARY ASSEMBLY
 D—LOW-RANGE CLUTCH ASSEMBLY
 E—OUTPUT SUMP PUMP ASSEMBLY
 F—REVERSE-RANGE PLANETARY ASSEMBLY
 G—LEFT STEERING CLUTCH ASSEMBLY
 H—STEERING CLUTCH COOLANT PUMP ASSEMBLY
 J—REVERSE-RANGE CLUTCH ASSEMBLY
 K—RIGHT STEERING CLUTCH ASSEMBLY
 L—HIGH-RANGE CLUTCH ASSEMBLY
 M—MAIN OIL FILTER ASSEMBLY
 N—STEERING DIFFERENTIAL ASSEMBLY
 P—STEERING CLUTCH SHAFT
 Q—PRESSURE CONTROL VALVE ASSEMBLY
 R—OUTPUT BRAKE AND PRESSURE PUMP ASSEMBLY
 S—LOCK-UP GOVERNOR AND RELAY VALVE ASSEMBLY
 T—CONVERTER LOCK-UP CLUTCH ASSEMBLY
 U—LEFT BRAKE APPLY MECHANISM ASSEMBLY
 V—LEFT END COVER ASSEMBLY
 W—LEFT END PLATE ASSEMBLY
 X—LEFT HOUSING ASSEMBLY
 Y—TORQUE CONVERTER ASSEMBLY
 Z—CONVERTER TURBINE ASSEMBLY SHAFT
 AA—TRANSMISSION INPUT SHAFT (COUPLING TO ENGINE)
 BB—TRANSMISSION INPUT SHAFT
 CC—FAN AND PUMP PINION SHAFT ASSEMBLY
 DD—INPUT BEVEL GEAR ASSEMBLY
 EE—INPUT SCAVENGE AND CONVERTER CIRCULATING PUMP ASSEMBLY
 FF—CONVERTER OUTPUT BEVEL GEAR SHAFT
 GG—RIGHT HOUSING ASSEMBLY
 HH—RIGHT END PLATE ASSEMBLY
 JJ—CROSS DRIVE SHAFT
 KK—RIGHT STEERING OUTPUT AND OUTPUT SUN GEAR ASSEMBLY
 LL—RIGHT OUTPUT SHAFT
 MM—RIGHT END COVER ASSEMBLY

Figure 14—Continued



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Figure 15. CD-500-3 and -4 cross-drive transmission—cutaway view.

A—RIGHT STEERING OUTPUT GEAR
 B—RIGHT END COVER
 C—STEERING OUTPUT PINION GEAR
 D—RIGHT STEERING CROSS SHAFT
 E—STEER OVER-SPEED LIMIT PUMP ASSEMBLY
 F—LEFT STEERING CROSS SHAFT
 G—CONVERTER PUMP DRIVE GEAR
 H—CONVERTER DRIVE GEAR
 J—INPUT DRIVEN BEVEL GEAR SHAFT
 K—STEERING VALVE BODY ASSEMBLY
 L—RANGE CONTROL VALVE BODY ASSEMBLY
 M—CLUTCH OIL ACCUMULATOR ASSEMBLY
 N—INPUT PRESSURE PUMP ASSEMBLY
 P—SUMP OIL FILTER ASSEMBLY
 Q—SUMP OIL FILTER DRAIN PLUG

Figure 15—Continued.

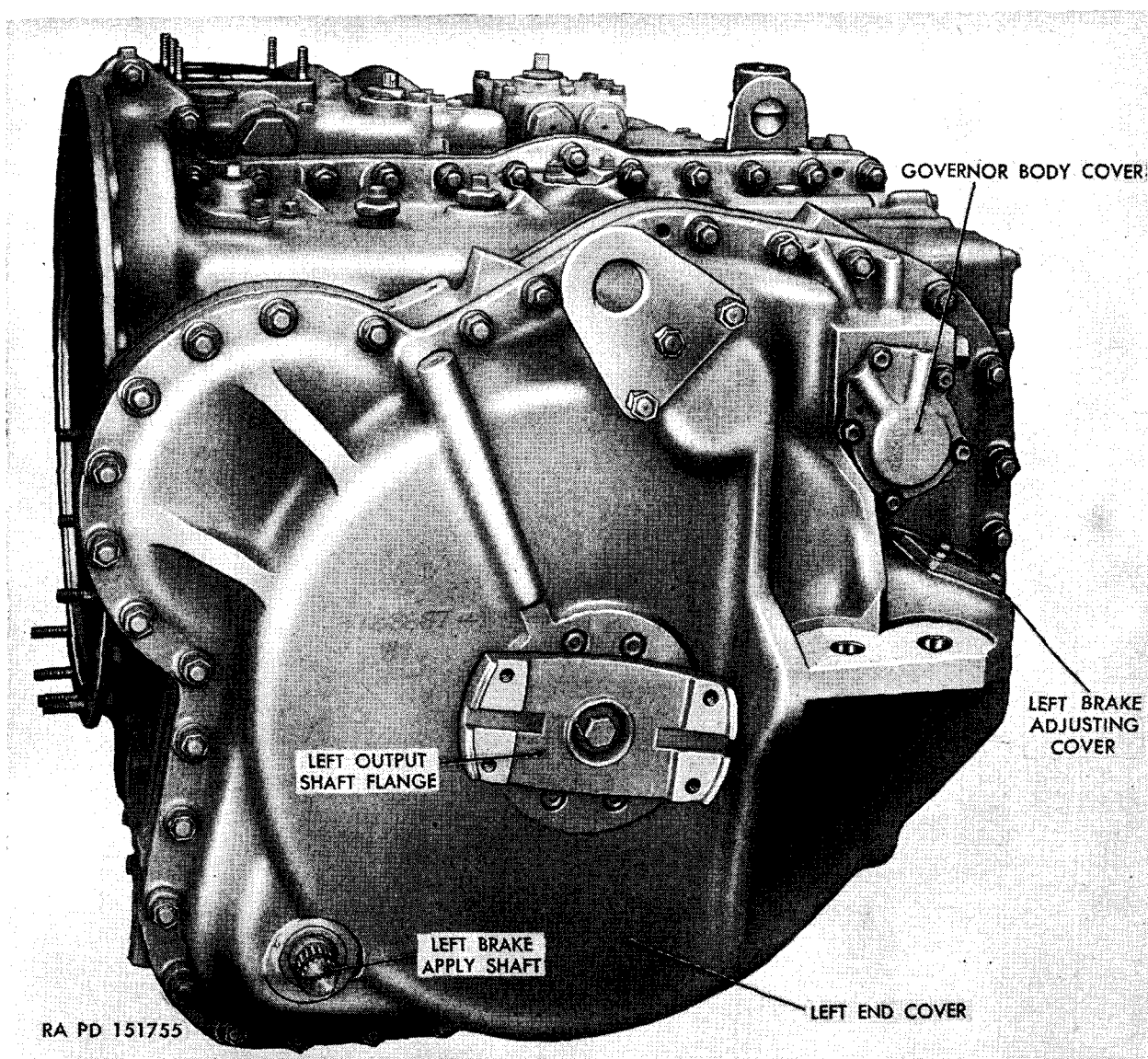


Figure 16. CD-500 cross-drive transmission—left side.

b. DIRECTIONS OF ROTATIONS. All references to direction are made from the position of the transmission in the vehicle (figs. 14 and 15). The front of the transmission is the end to which the engine mounts and the opposite end is the rear. The left and right ends of the transmission are determined by viewing the transmission from the rear. Rotations of gears and shafts which rotate around a longitudinal axis are determined also by viewing the transmission from the rear. Rotations of gears and shafts which rotate around a transverse axis are determined by facing the right end of the transmission.

16. Hydraulic and Lubrication Systems

a. GENERAL. The hydraulic and lubrication systems function under various systems (figs. 18 and 19). The operations of these systems are described in *b* through *g* below. All the systems use one supply of oil. The oil should be kept at its proper level. The oil level indicator, located in the oil filler neck at the right rear corner of the transmission has a "FULL" mark and an "ADD" mark. Never allow the oil level to go below the "ADD" mark. This check should be made with the transmission hot and the engine idling. The oil should be changed every 1,000 miles unless

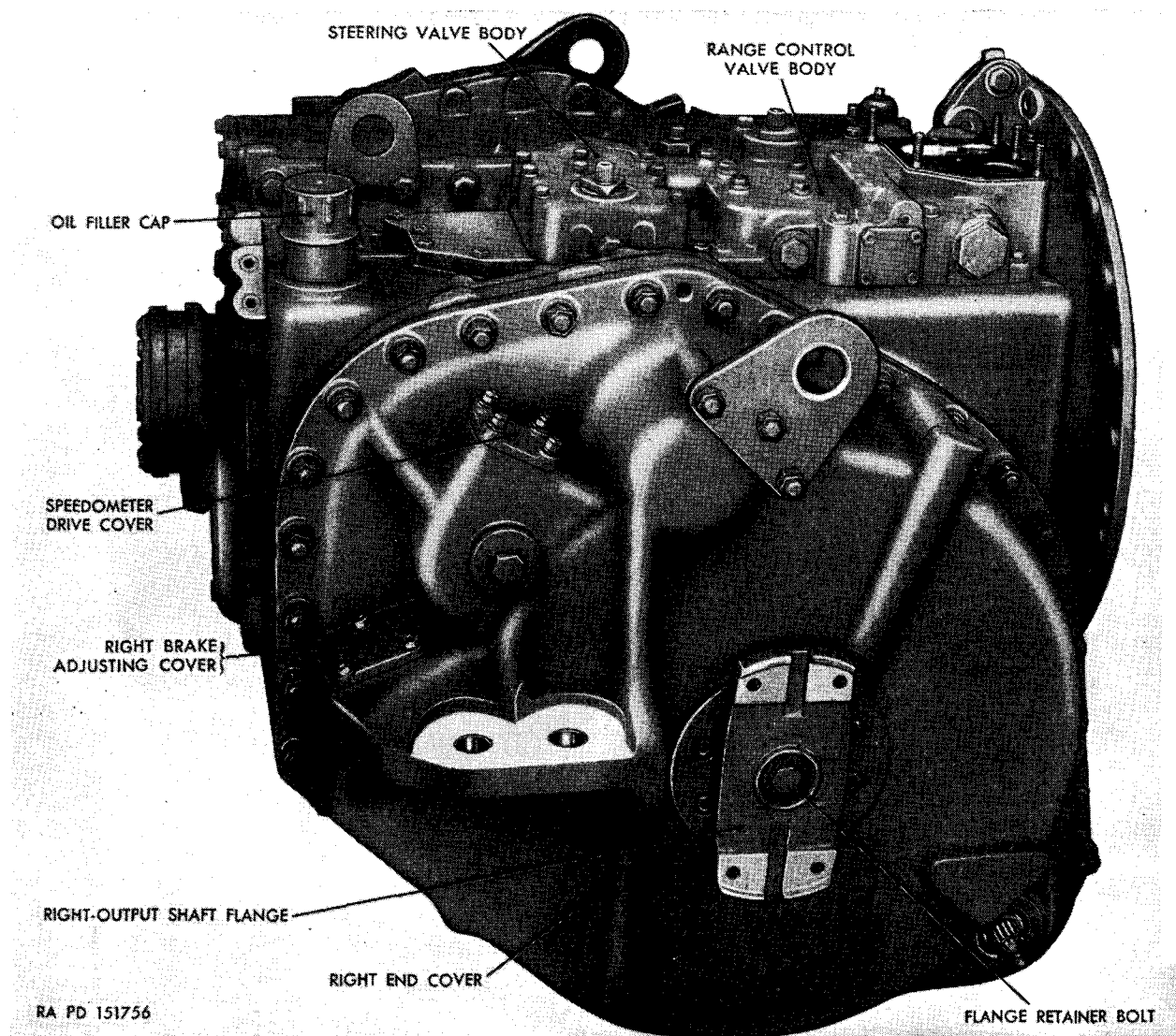


Figure 17. CD-500 cross-drive transmission—right side.

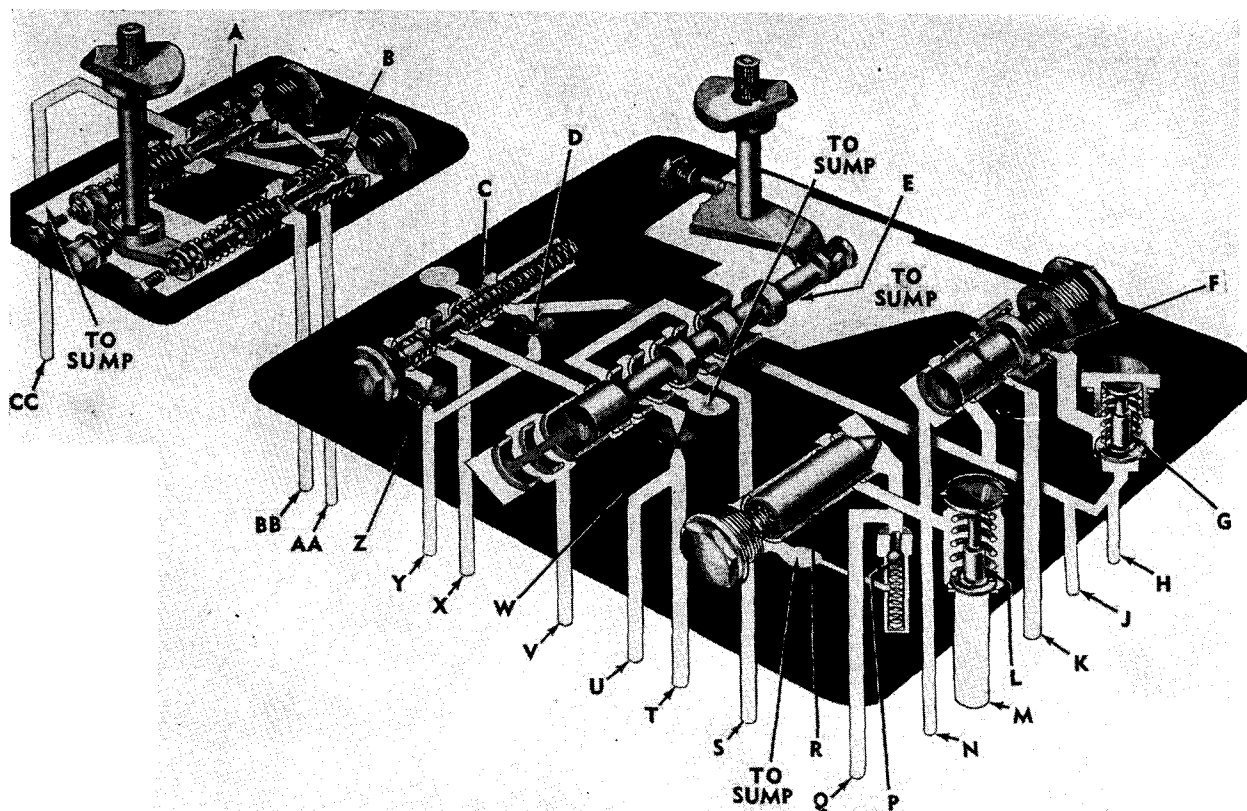
there is an internal failure which would require an earlier change. The sump oil filter, main oil filter, and converter oil filter should be inspected and cleaned at the time of each oil change.

b. **MAIN OIL SYSTEM.** The input-scavenge pump (a component of the input scavenge and converter circulating pump) and the output-sump-pump, draw oil from the sump through the sump filter and pump it to the reservoir. This keeps the sump empty. The input-pressure pump draws oil from the reservoir and pumps it to the main filter. As the flow leaves the main filter, it branches and goes to the range-control valve, steering valves, converter lock-up governor and relay valve, brake-lube signal valve, and the main-pressure regulator valve. The main-pressure regu-

lator valve maintains 150 psi pressure in the main oil system by directing oil into the converter system. Should the main-pressure regulator valve stick when closed, the safety valve will open at 230 psi, relieve the oil pressure in the system and return oil to the sump.

c. **HYDRAULIC CONTROLS SYSTEM.**

(1) *Range control.* The range-control valve (fig. 18) directs main oil pressure to the range-control clutches. Its design is such that it cannot direct the pressure to more than one clutch at a time. If the valve is in neutral-range position, it is closed and no pressure is passed. In low-range position the valve admits pressure into the passage leading to the



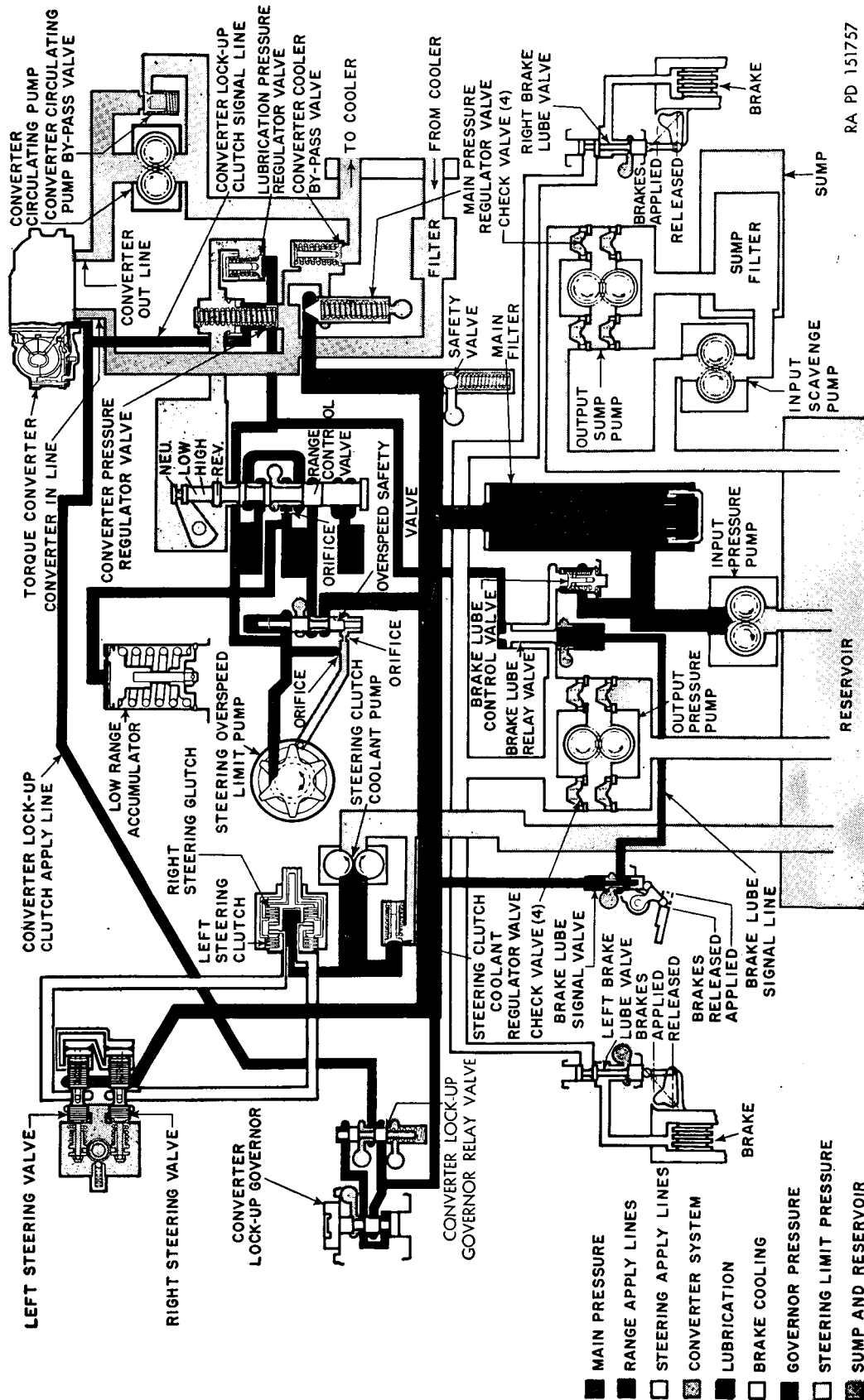
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|--------------------------------------|--------------------------------------|
| A—RIGHT-STEERING VALVE | P—MAIN-PRESSURE RELIEF VALVE |
| B—LEFT-STEERING VALVE | Q—MAIN PRESSURE |
| C—STEERING-OVERSPEED SAFETY VALVE | R—MAIN-PRESSURE REGULATOR VALVE |
| D—ORIFICE | S—TO HIGH-RANGE CLUTCH |
| E—RANGE CONTROL VALVE | T—TO LOW-RANGE CLUTCH |
| F—CONVERTER-PRESSURE REGULATOR VALVE | U—TO LOW-RANGE ACCUMULATOR |
| G—LUBRICATION REGULATOR VALVE | V—TO REVERSE-RANGE CLUTCH |
| H—TO LUBRICATING SYSTEM | W—LOW-RANGE ORIFICE |
| J—TO STEERING-OVERSPEED LIMIT PUMP | X—MAIN PRESSURE |
| K—TO CONVERTER LOCK-UP CLUTCH | Y—FROM STEERING-OVERSPEED LIMIT PUMP |
| L—COOLER BY-PASS VALVE | Z—ORIFICE |
| M—FROM CONVERTER | AA—MAIN PRESSURE |
| N—TO CONVERTER | BB—TO LEFT-STEERING CLUTCH |
| | CC—TO RIGHT-STEERING CLUTCH |

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Figure 18. Control valve and steering valve body schematic.

low-range clutch. If moved into high-range position, the valve directs the low-range clutch oil pressure to sump. Simultaneously the valve directs oil pressure to the passage leading to the high-range clutch. When reverse range is selected, the valve relieves the pressure in the high-range clutch line and admits

oil pressure into the passage leading to the reverse-range clutch. Regardless of the range from which the shift is made and the range into which it is made, the range-control valve simultaneously releases one clutch and engages another. If the shift is made into neutral, one clutch is released and one is engaged.



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Figure 19. Oil flow schematic.

The range-control valve is operated mechanically from the driver's compartment by a linkage system. Connected to the low-range clutch passage is an accumulator which "softens" the engagement of the low-range clutch.

- (2) *Steering control.* The right- and left-steering valves receive main oil pressure (150 psi) from the main oil system. These valves are modulating-type valves and therefore are capable of delivering variable pressures, up to 150 psi, to the steering clutches (fig. 18). The right- and left-steering valves are connected by oil passages to the right- and left-steering clutches, respectively. The steering valves are operated mechanically from the driver's compartment by a system of linkages. If a right steer is applied, the right-steering valve passes oil pressure to the right-steering clutch. The amount of pressure to the clutch is proportionate to the percentage of full steer applied. Thus, if the steering control in the driver's compartment is moved to the right one half of its full travel, approximately one half of main oil pressure will be sent to the right-steering clutch by the right-steering valve. If a full right steer is applied, the valve sends full main oil pressure to the clutch. Variable steering is accomplished in this manner. A left steer is obtained in the same manner. The design of the steering valves and the mechanical interconnections eliminates the possibility of having both right- and left-steering clutches engaged at the same time.

d. CONVERTER SYSTEM. Oil which is passed by the main-pressure regulator valve enters the converter system (fig. 19). The oil which is displaced in the converter system leaves through the converter-pressure regulator valve and enters the lubrication system. The converter-pressure regulator valve regulates the pressure in the converter system to 80 psi. The converter system, including the converter, is kept full of oil at 80 psi pressure. Circulation of the oil within the converter system is maintained by the converter circulating pump (a component of the input scavenge and converter circulating pump). The oil flows from the pump to the external cooler to

the converter and back to the pump. A by-pass around the cooler incorporates a by-pass valve set at 80 psi. There is also a by-pass around the circulating pump which includes a by-pass valve set at 1.8 psi. The circulation of oil through the coolers provides cooling for the converter. Since oil is continuously entering the converter system from the main oil system and passing through to the lubrication system, this circulation through the coolers also provides cooling for the entire hydraulic system.

e. LUBRICATION SYSTEM. Pressure in the lubrication system is regulated to 30 psi by the lubrication-pressure regulator valve (fig. 19). The oil is directed through a system of passages to all components which require lubrication and then drains back to sump. Oil which is not required to maintain the pressure is by-passed to sump.

f. BRAKE COOLING SYSTEM.

- (1) The output brake and pressure pump draws oil from the reservoir and pumps the oil into the brake-lubrication lines leading to the right- and left-brake lubrication valves. The pump contains four check valves arranged to enable the pump to provide oil pressure to the brake lubrication lines whether the vehicle is going forward or backward. When the brakes are released, the oil from the output brake and pressure pump is returned to sump through the brake-lubrication relay valve. This reduces the horsepower required to drive the transmission.
- (2) When the brakes are applied, the brake-lubrication signal valve passes main oil pressure to the spring end of the brake-lubrication-relay valve. This pressure helps the spring to overcome the lubrication system pressure acting against the other end of the relay valve. This causes the valve to close shutting off its sump opening. The full flow of the output brake and pressure pump is directed through the brake lubrication lines to the right- and left-brake lubrication valves. Simultaneously, the right- and left-brake lubrication valves open and direct the flow of cooling oil through the right- and left-brake disks. If the brake-lubrication pressure exceeds the main oil pressure by more than 100 psi while the brakes are applied, the brake-lubrication control

valve opens and passes oil from the brake-lubrication lines into the main oil system.

- (3) When the brakes are released, the right- and left-brake-lubrication valves close. This shuts off the cooling flow into the brakes and returns the oil to sump. Simultaneously, the brake-lubrication signal valve closes and returns to sump the oil that was in the line leading to the spring end of the brake-lubrication relay valve. This allows the lubrication system pressure acting against the anti-spring end of the relay valve to overcome the relay valve spring and open the valve. Therefore, the flow of oil from the output brake and pressure pump returns to sump.

- (4) During a push start or if the vehicle engine should stop with the vehicle in motion, main oil pressure is provided by the output brake and pressure pump. With lubrication system pressure below 15 psi, the brake-lubrication relay valve closes. This prevents the oil flowing from the output brake and pressure pump, from returning to sump. Since the brakes require no flow, the pressure in the brake line immediately overcomes the spring in the brake-lubrication control valve and opens the valve. The entire flow from the output brake and pressure pump then passes through the brake-lubrication control valve into the main oil system to provide main oil pressure.

g. MINOR OIL SYSTEMS.

- (1) *Converter lock-up clutch.* The lock-up governor and lock-up governor relay valve receive main oil pressure from the main oil system (fig. 19). The governor is driven at a fixed ratio proportional to transmission output speed. When the governor rotates, its weight exerts a force which moves the governor toward its open position. As governor speed increases, the pressure on the head of the relay valve increases until it overcomes the relay valve spring. The port which admits main pressure to the relay valve opens at the same instant that the valve opening to the sump closes. The relay valve is so designed that as main oil pressure enters, it assists governor pressure to overcome the spring tension completely and to open the valve

quickly. This provides quick engagement. The relay valve passes main pressure on to the converter lock-up clutch, engaging it. Converter lock-up clutch pressure (main pressure) is simultaneously sent to the converter-pressure-regulator valve through the converter lock-up clutch signal line. This pressure acts against the converter-pressure-regulator-valve spring and opens the valve. This causes converter pressure to drop to lubrication system pressure. At a vehicle speed lower than the speed at which lock-up occurs, governor pressure decreases. This enables the relay valve spring to overcome governor pressure and close the relay valve. This shuts off the oil pressure to the lock-up clutch and returns the oil remaining in the line to the sump. The relay valve is designed so that its final closing is quick. Because of this, the converter lock-up clutch is not slipped under load as it disengages. The oil pressure in the converter lock-up clutch signal line is also directed to sump. This allows the converter-pressure-regulator valve to resume control of converter pressure and bring it back up to 80 psi.

- (2) *Steering overspeed limit pump.* Lubrication system oil is fed to the steering overspeed limit pump which is driven by the left steering cross shaft (figs. 14, 15, and 19). During normal steering, the pump merely circulates oil from its output to its input through an orifice. The pump output pressure acts against the antispring end of the overspeed safety valve. In the event of a failure, which results in a tendency to overspeed the steering system, the pump output pressure rises and overcomes the spring in the overspeed safety valve closing the valve. This shuts off main pressure to the range control valve and puts transmission operation in neutral. When the overspeed safety valve is in its closed position, main oil pressure is admitted to the end opposite the spring end of the valve. This holds the valve closed and keeps main pressure to the range control valve shut off until the engine is stopped, even though the steering overspeed limit pump has slowed or stopped.

- (3) *Steering clutch cooling.* The steering-clutch-coolant pump draws oil from the reservoir and pumps the oil to the steering-clutch-coolant valves. The oil pressure to the valves is regulated to 54 psi by the steering-clutch-coolant-regulator valve. With the steering clutches disengaged, the coolant valves are closed and only a metered flow is passed through the valves to keep the clutches wet. As a steering clutch engages, its coolant valves open and admit a full cooling flow of oil to the clutch disks. When the clutch disengages, the coolant valves close and again only a metered flow is passed into the clutch.

17. Planetary Gearing

a. GENERAL. The CD-500 transmission contains four planetary gear trains (figs. 14 and 22). They are—the low-range planetary, the reverse-range planetary, and the two output planetaries. The low- and reverse-range planetaries are located in the right housing of the transmission. At each end of the cross-drive shaft is an output planetary which drives the output flanges. Each planetary gear train consists of a sun gear meshed with a planet pinion carrier assembly. The carrier assembly, containing four planet pinions, meshes with a ring gear. The function of the planetaries, the high-range clutch, and the cross-drive shaft are given in *c* through *g* below.

b. PLANETARY GEAR PRINCIPLE.

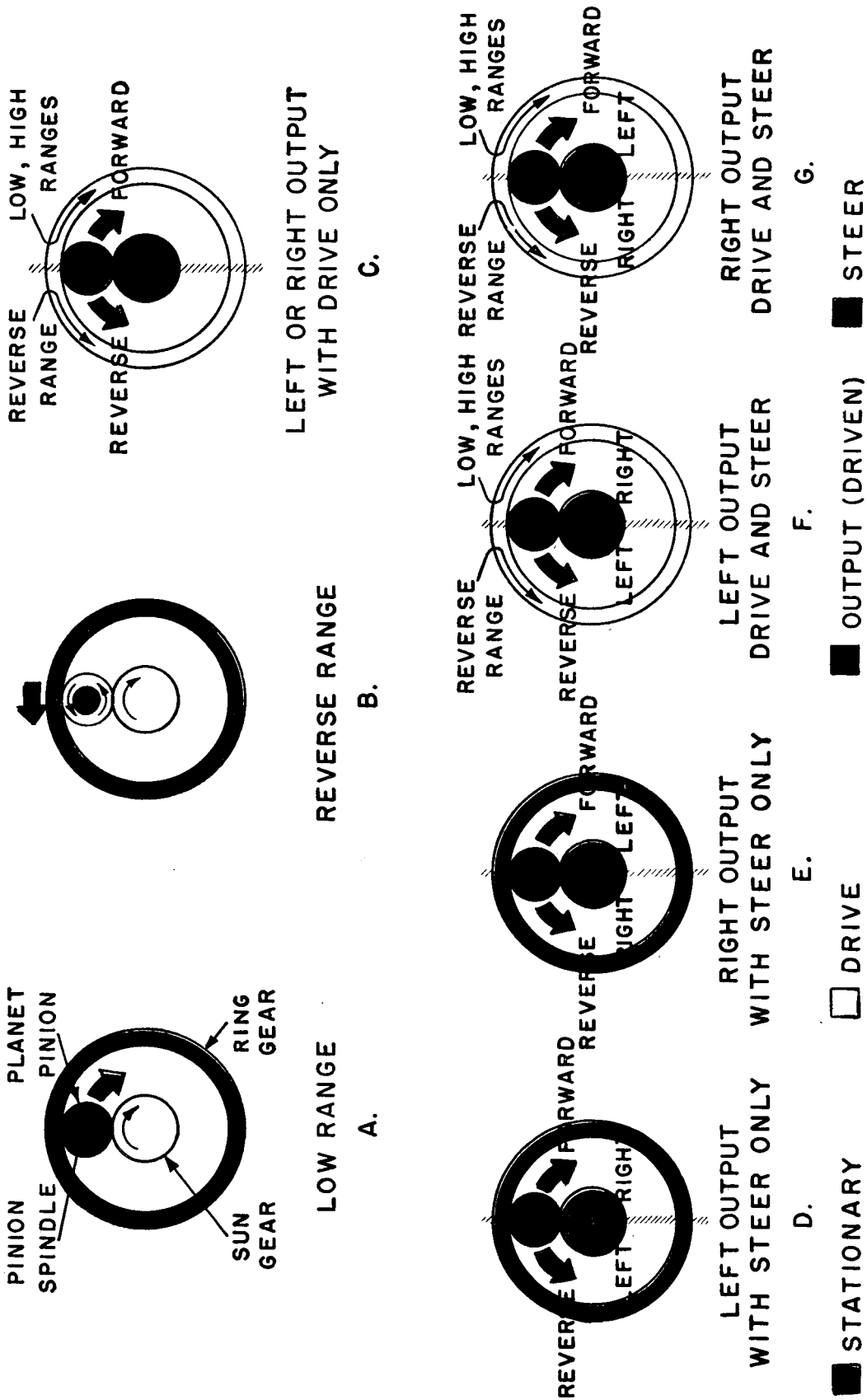
- (1) In its simplest form, a planetary gear set consists of three gears (fig. 20). In the center is the sun gear. Meshing with the sun gear is a planet pinion. On the outside of the planet pinion is the ring gear—an internally splined gear meshing with the planet pinion. The planet carrier holds the pinion on a spindle and allows it to rotate. By holding any one of the two gears or planet pinion carrier stationary and causing either of the other two to be the driving or driven member, six gear reductions can be made.
- (2) An example is shown in A of figure 20. The sun gear is the driving member and the ring gear is being held stationary. Because of the drive from the sun gear, the planet pinion must rotate. It cannot stand still and rotate on its spindle

because the ring gear would have to rotate. The ring gear cannot rotate because it is being held stationary. So the planet pinion will have to move around the ring gear, taking with it the planet carrier.

- (3) The planet carrier, which is driving the output shaft, will be driven at a slower rotation than the input drive to the sun gear. This is how a reduction of speed and an increase in torque is obtained. The ratio obtained depends on the size of the gears. If the ring gear is driving and the sun gear is held stationary, a different torque ratio will be obtained than the one previously described (C of fig. 20).

c. LOW RANGE (figs. 14 and 23).

- (1) In mesh with the low-range sun gear are four planet pinions. These pinions rotate on spindles which are attached to the low-range planet carrier. The internal teeth of the low-range ring gear mesh with the planet pinions. Splined to the outer circumference of the ring gear are three internally splined steel disks.
- (2) Alternating with the three internally splined disks are four externally splined disks, two with bronze facing on both sides and two with bronze facing on one side. There is one disk with bronze facing on one side at each end of the low-range clutch pack. The four bronze-faced disks spline with the inner circumference of the low-range ring, which is bolted to the right transmission housing. The low-range piston is on the left side of the low-range clutch pack, as shown in D of figure 14.
- (3) When hydraulic pressure is applied against the low-range piston, the piston is actuated, causing the bronze and the steel disks to lock together. This action locks the ring gear to the stationary low-range ring.
- (4) The driving power of the low-range sun gear is transmitted to the planet pinions. As the ring gear is held stationary, the planet pinions are forced to walk around the inner circumference of the ring gear, carrying with them the low-range planet carrier. This drive is transmitted to the right output ring gear.
- (5) The cross-drive shaft, being splined to



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Figure 20. Planetary principle schematic.

the right output ring gear, transmits the rotation to the left output ring gear. Both output ring gears rotate at 0.262 times converter-turbine speed.

Note. All speed ratios are based on the assumption that the converter is operating in lock-up.

- (6) When hydraulic pressure is released from the piston, spring tension forces the piston away from the bronze and the steel disks. This releases the disks and frees the low-range ring gear.

d. HIGH RANGE.

- (1) The high-range clutch housing, clutch outer-drive ring, and clutch pinion are bolted together. Integral with the high-range clutch pinion are the reverse-range sun gear and the low-range sun gear.
- (2) Splined to the inner circumference of the clutch outer-drive ring are five externally splined steel disks. The clutch inner-drive-range hub is contained within the clutch outer drive ring. Splined to the outer circumference of this hub are five internally splined bronze disks. The bronze and steel disks are alternated in the clutch pack. Contained within the high-range clutch housing is the high-range clutch piston.
- (3) When hydraulic pressure is applied against the piston, the piston causes the clutch disks to lock together. Drive is transmitted from the high-range clutch housing, through the clutch disks, to the clutch inner-drive-range hub.
- (4) The clutch inner-drive-range hub is splined to the cross-drive shaft which extends to both output ring gears. So, the drive from the converter is transmitted through the high-range clutch to the output ring gears at a 1.0 to 1.0 ratio.
- (5) When hydraulic pressure is released from the piston, spring tension forces the piston away from the clutch disks. This releases the disks and stops the flow of power from the high-range clutch housing to the clutch inner drive range hub.

e. REVERSE RANGE.

- (1) In mesh with the reverse-range sun gear are four planet pinions. These pinions are mounted on spindles which are attached to the reverse-range planet

carrier. Bolted to the left side of the planet carrier is the reverse-range hub. Splined to the outer circumference of the hub are five internally splined steel disks.

- (2) Alternating with the five internally splined steel disks are six externally splined disks, four with bronze facing on both sides and two with bronze facing on one side. There is one disk with bronze facing on one side at each end of the clutch pack. The six bronze-faced disks spline with the inner circumference of the reverse-range ring, which is bolted to the right end plate. The reverse range piston is on the right side of the reverse range clutch pack, as shown in J of figure 14.
- (3) When hydraulic pressure is applied against the reverse-range piston, the piston is actuated and causes the bronze and steel disks to lock together. This action locks the reverse-range hub to the stationary reverse-range ring. The reverse-range planet carrier, also is held stationary because it is bolted to the reverse-range hub.
- (4) The driving power of the reverse-range sun gear is transmitted to the planet pinions. When the planet carrier is held stationary, the planet pinions must rotate on their spindles. The rotation of the planet pinions drives the reverse-range ring gear in a reverse direction. The ring gear is bolted to the low-range planet carrier which, in turn, is bolted to the right output ring gear. Consequently, the reverse rotation is transmitted from the reverse-range ring gear to the right-output ring gear.
- (5) The cross-drive shaft, being splined to the right output ring gear, transmits this reverse rotation to the left output ring gear. Both output ring gears rotate at 0.262 times converter-turbine speed.

Note. All speed ratios are based on the assumption that the converter is operating in lock-up.

- (6) When hydraulic pressure is released from the piston, spring tension forces the piston away from the clutch disks. This releases the disks and frees the reverse-range hub from the reverse-range ring.

f. OUTPUT PLANETARIES. When the vehicle is being driven in either a forward or reverse direc-

tion (no steer), the output-sun gears are locked in a stationary position (because of the steering differential action) while the output ring gears are driving the output planetaries. In low and reverse ranges, the right-output-ring gear is driven by the low-range planet carrier. The cross-drive shaft, splined to both output ring gears, transmits the drive from the right to the left-output ring gears. In high range, the cross-drive shaft is driven by the high-range clutch hub and drives the output ring gears. When the vehicle is being steered, the output planetaries are also driven by the output sun gears (par. 19b). The output planet pinions are driven either by the output ring gear, or the output sun gear—or a combination of both. The planet pinions are mounted on spindles which are assembled to each output planet carrier. An output shaft, which splines to an output flange, is bolted to each output planet carrier.

g. MAIN CROSS SHAFT. The main cross shaft, commonly called the cross-drive shaft, connects the left and right output planetaries of the transmission. Three assemblies are splined to the main cross shaft: the high-range clutch hub, the right-, and the left-output ring gears.

18. Hydraulic Torque Converter

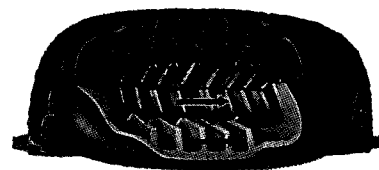
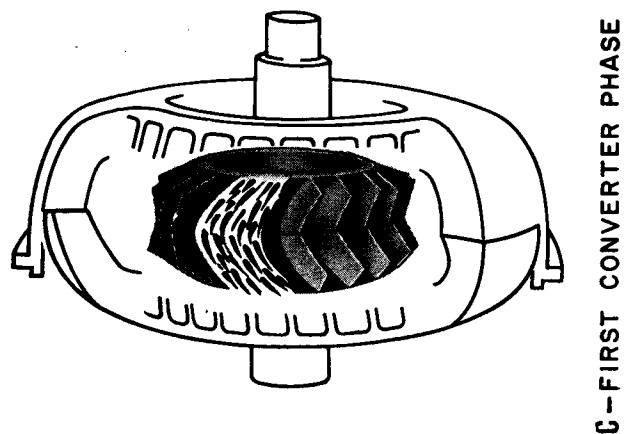
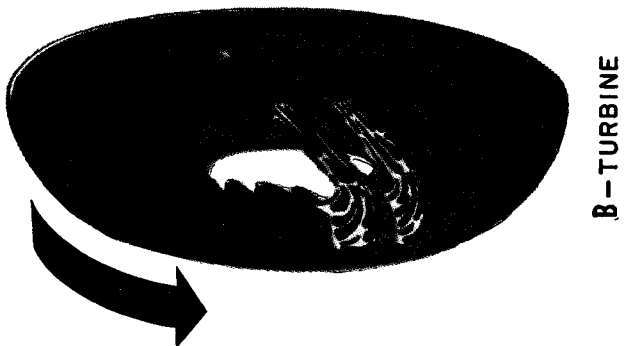
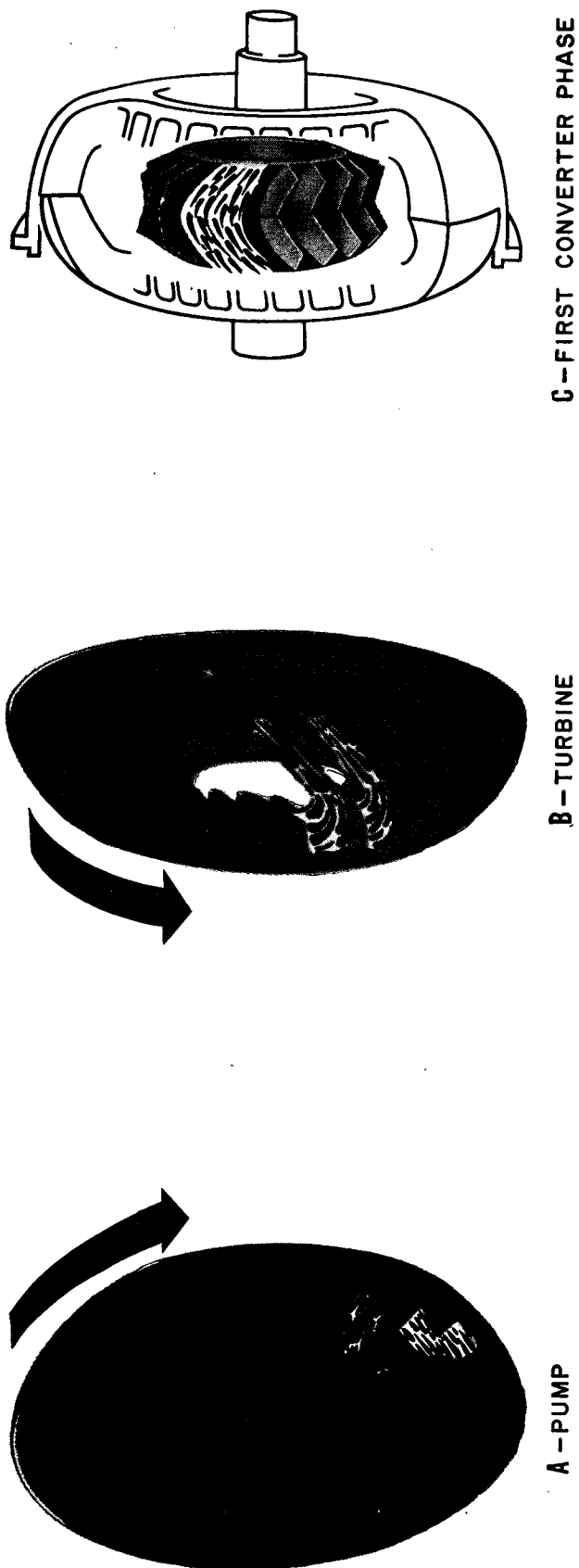
a. GENERAL. The hydraulic torque converter is a polyphase, single stage, four element converter (fig. 14) providing a maximum torque multiplication of 4 to 1. The phases in which it operates are converter and coupling. Converter phase means that the converter is multiplying the torque, or twisting effort of the engine, in infinitely variable ratios within the converter's range. Coupling phase means that the converter is functioning as a fluid coupling in which case the output torque of the converter can never exceed the input torque from the engine. Single stage means that the turbine requires only one stage of oil passage through the turbine to provide the necessary torque multiplication. The four elements of the converter are the pump, turbine, first stator, and second stator. When in operation, the converter and its cooling system are kept filled with oil under pressure. It is supplied by the input-pressure pump through the main-pressure regulator valve. The converter circulating pump (a component of the input scavenge and converter circulating pump) keeps the oil circulating throughout the converter and the cooling system. Torque multiplication is explained in *e* below.

b. PUMP.

- (1) The pump (A of fig. 21) is the driving member of the torque converter and is driven at 1.4 (CD-500-3) or 1.3 (CD-500-4) engine speed. The pump, lock-up clutch main plate, and lock-up piston housing form an oil tight enclosure, within which the other converter elements operate. The pump starts when the vehicle engine is started.
- (2) It is the function of the converter pump to transmit engine power hydraulically to the turbine. The pump revolves and moves the oil in the direction of pump rotation. The oil is moved by centrifugal force from the center of the pump toward the outer circumference. The vanes of the pump are curved backward to the rotational direction to throw the oil against the turbine blades at a predetermined angle.

c. TURBINE.

- (1) The turbine (B of fig 21) is the driven member of the converter. Splined to the right end of the turbine shaft is the converter-output-bevel-gear shaft which transmits both the driving and the steering power.
- (2) It is the function of the turbine to convert the force of the oil into torque which is transmitted to the converter output shaft. The turbine has sharply curved blades to catch the speeding oil from the pump. The turbine blades extract maximum force from the passing oil by changing the direction of oil flow to the maximum degree. As the oil whirls into the outer channels of the turbine, the turbine rotates. The oil moves from the outer circumference to the center. As the oil leaves the turbine, it is traveling in a direction opposite to the rotation of the pump and turbine. Because the oil leaves the turbine through smaller sectional passages than it entered, at low turbine speed conditions the oil emerges with greater velocity than it possessed when it entered the turbine. Oil leaving the turbine still has force, but the oil is now traveling in the wrong direction. It will work against the pump unless the direction of the oil flow is



D - SECOND CONVERTER PHASE

E - COUPLING PHASE

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Figure 21. Converter principle schematic.

changed to help instead of hinder the pump (*d* and *e* below).

d. STATORS.

- (1) The first and second staters (C of fig. 21) are mounted on freewheel (overrunning) clutches which rotate on the converter ground sleeve. The ground sleeve is bolted to an inside shoulder of the left transmission housing. The staters are located between the inner circumferences of the pump and turbine.
- (2) It is the function of the staters to obtain torque multiplication within the converter by redirecting the flow of oil into the same direction of rotation as the pump. They can spin freely in the direction of pump rotation and engine rotation but lock when backward pressure is applied. When oil, speeding backward from the turbine, strikes the staters they lock, thus providing a base to force the oil to change direction. It then enters the pump at the hub and in the same direction the pump is rotating. Torque multiplication is explained in *e* below.

e. TORQUE MULTIPLICATION.

- (1) The instant the converter pump rotates, the oil inside the converter spins around with the pump. This movement of oil is called rotary flow. However, the shape of the converter together with the vanes within the converter causes the oil to take a second path of travel across the rotary flow. This second path is called vortex flow and is necessary for torque multiplication. The vortex flow is greatest at stall or slow speeds which call for high output torque. The flow within the converter is outward from the pump to the turbine, then through the turbine inward where it passes through the first stator, the second stator, and back into the pump.
- (2) The force which is contained in the moving oil is not entirely absorbed by the turbine. The oil slides through the turbine when there is resistance to its turning. This resistance is the load on the converter output shaft. *The staters at low turbine speed and high torque demand, change the direction of the oil flow from the turbine in such a way that the*

remaining force aids the pump instead of hindering it. The oil leaving the turbine still has force but would be traveling opposite to the pump rotation, hindering it, if it were not for the redirecting action of the staters. *This redirection of the oil by the staters gives torque multiplication.*

- (3) Up to this point the action discussed has concerned getting a load under way. The pump has been revolving at a faster speed than the turbine. As the torque demand decreases, the turbine speeds up in relation to the speed of the pump. This causes the oil to slow down as it leaves the turbine. With sufficient drop in the velocity the oil no longer acts upon the concave or front side of the stator blades but is thrown partly against the back face of the first stator. The force of the oil against the back face of the first stator causes it to rotate in the same direction as the turbine, the direction of rotary flow (D of fig. 21).
- (4) With further increase in the relative speed of the turbine as the speed of the vehicle increases, the oil flow changes direction still further causing the second stator to freewheel with the first (E of fig. 21). From there on torque multiplication stops and the converter acts as a fluid coupling.
- (5) Whenever additional torque is needed to counter a sudden increase in load, torque multiplication is immediately available in exactly the amount needed, within the range of the converter. The torque demand at the output flanges determines the phase, coupling or converter, and automatically adjusts the torque ratio when in the converter phase.

f. LOCK-UP. When the relation between throttle opening and the vehicle speed reaches a predetermined point, the lock-up clutch automatically engages. The clutch locks the turbine to the pump, transmitting the power mechanically through the converter. Lock-up occurs only in high-range (fig. 25).

19. Power Paths

a. INPUT DRIVING PATH.

- (1) Driving power is delivered from the engine to the transmission input shaft by a splined coupling. Splined to the front part of the transmission input shaft

is the fan-drive spur gear which is in mesh with the fan and pump pinion. The front part of the pinion (on its left side) drives the fan-drive idler gear. The idler gear is in mesh with and drives a fan-drive gear. Splined to the fan-drive gear is the fan-drive coupling. The coupling is driven at 0.663 engine speed and is suitable for transmitting 40 hp at 1,856 maximum rpm. A fan-drive kit is available for use on the right side.

- (2) The fan-drive gear drives the input-pressure-pump drive gear, to which is splined the input-pressure-pump drive shaft. The drive shaft is the source of the power for the input pressure pump located in the lower rear of the left transmission housing. Meshed with the front part of the fan and pump pinion (on its right side) is the input scavenge and converter circulating pump drive gear. In mesh at the bottom of the drive gear is the pump drive shaft which provides input power to the pump drive and idler gears.
- (3) For the remaining gears driven by the transmission input shaft, see paragraph 6b. The two converter drive spur gears constitute an important difference in the two models of the CD-500.

b. HYDRAULIC DRIVING PATH.

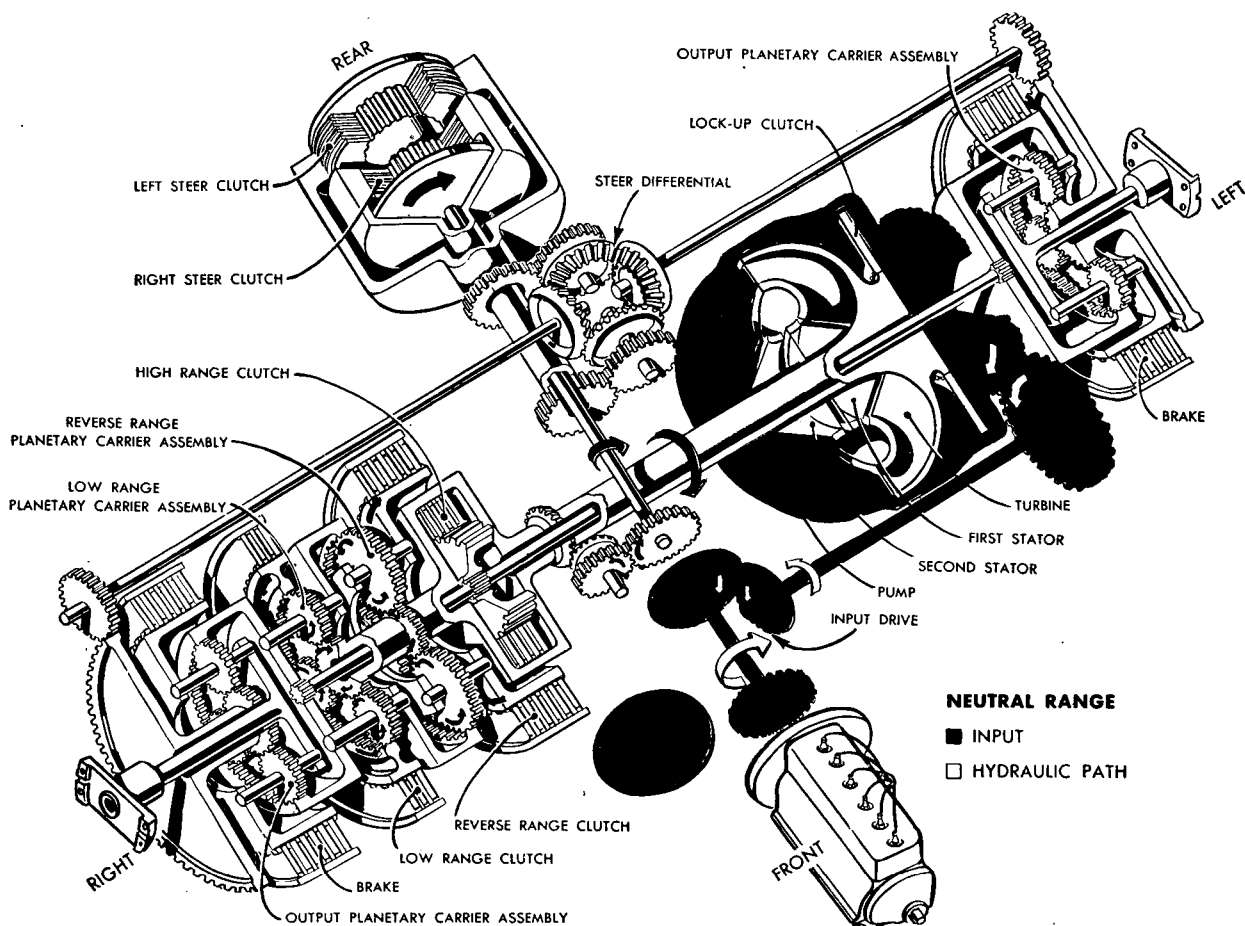
- (1) The hydraulic driving power path provides a source of power for low, high, and reverse range operation, as explained in (2) below, and also provides a source of power for the operation of the left and right steering clutches, as explained in (3) below.
- (2) Hydraulic driving power, originating in the torque converter, is transmitted from the converter-turbine shaft, through the converter-output-bevel-gear shaft to the high-range clutch housing (fig. 14). The high-range clutch housing, the clutch outer drive ring, and the high-range clutch pinion are bolted together. The reverse-range sun gear and the low-range sun gear are integral with the high-range clutch pinion. Consequently, hydraulic driving power is directed to the output ring gears from any one of three points: the high-range clutch housing, the low-range sun gear, or the reverse-range sun gear.

- (3) The converter-output-drive bevel gear is splined to the converter-output-bevel-gear shaft (fig. 14). The converter-output-drive-bevel pinion meshes with the front portion of the converter-output-drive-bevel gear. This pinion drives the converter-output-drive-transfer gear. The converter-output-driven-transfer gear, directly above and meshing with it, splines to and drives the steering clutch shaft. The steering clutch shaft extends to the upper rear of the transmission housing and at that point powers the steering-clutch-coolant pump. The steering-clutch-main plate is an integral part of the steering clutch shaft.
- (4) The steering clutch assembly is composed of the steering-clutch main plate and the steering-clutch backing plate, between which are the steering-clutch-inner-hub assembly, the left- and right-splined-inner ring gears, the left and right piston assembly, and the left and right steer clutches. The assembly is bolted together and so unites with the steering-clutch shaft.

c. STEERING POWER PATH.

- (1) Splined to *each* inner ring gear are four internally-splined steel plates. Alternated between these four plates are four externally-splined plates "faced" with bronze on both sides. The four bronze "faced" plates in the rear of the steering clutch assembly spline with the left steering clutch splined ring. The four bronze "faced" plates in the front of the steering clutch assembly spline with the right steering clutch shaft.
- (2) The steering clutch inner hub assembly, bolted to the clutch main plate, rotates with that plate. The inner hub sleeve is secured to the inside of the inner hub by two dowel pins and rotates around the steering clutch oil transfer sleeve which is bolted to the transmission rear cover. Drilled passages in the rear cover, the transfer sleeve, the inner hub sleeve, and the inner hub are matched in order to provide oil pressure to both the left and the right steering pistons. The matched passages also provide lubricating oil for the steering clutch assembly.

- (3) Assembled in each side of the steering clutch inner hub are four cooling oil valves. There are 24 pins around the outer circumference of the inner hub, which position the 24 steering clutch springs. *The left steering piston is located at the rear of the steering clutch assembly and the right piston is located at the front.* The two pistons are bolted together and are under spring pressure from the clutch springs. The design is such that the spring pressure on each piston holds them in the neutral position when steer clutch pressure is not being sent to either clutch.
- (4) When left steer is selected, the left steering valve allows oil pressure to actuate the left steering piston. The action of the piston locks the internally-splined rotating steel plates to the externally-splined stationary bronze plates *in the rear of the steering clutch assembly.* The left steering piston is bolted to the right steering piston; therefore, the movement of the left piston moves the right piston against its clutch springs. When the steering lever is moved to no-steer, the oil pressure behind the left steering piston is released and the piston returns to its neutral position. The spring pressure on the right steering piston aids in returning the left steering piston. The clutch springs, acting in opposite directions, cause the pistons to return to the neutral position and hold them there when the pistons are not actuated.
- (5) Right steer is similar, except that the internally-splined rotating steel plates are locked to the externally-splined stationary bronze plates *in the front of the steering clutch assembly.*
- (6) The right steering clutch shaft, which is encircled by the left steering clutch shaft, and ring gear, extends to the upper center of the transmission. Splined to the inner circumference of the right steering clutch shaft are four externally splined bronze clutch plates. Splined to the smaller outer circumference of the shaft and ring gear is the right steering pinion gear. A steering differential spur gear, mounted directly above and meshing with the pinion gear, drives the right steering bevel pinion. This bevel pinion faces the rear of the transmission.
- (7) The left steering clutch shaft is driven by the left clutch steering shaft splined ring. The left clutch shaft is splined, on its smaller outer circumference, to the left steering pinion gear. A steering differential spur gear, mounted directly above and meshing with the pinion gear, drives the left steering bevel pinion. This bevel pinion faces the front of the transmission.
- (8) The differential is completed by two steering bevel gears which are mounted on the left and right sides of the bevel pinions. Therefore, each bevel pinion meshes with both steering bevel gears. Each steering bevel gear is splined to a steering cross shaft. Each steering cross shaft extends to an end cover where it drives a steering output pinion gear. This pinion gear meshes with a steering output gear which is bolted to and drives an output sun gear.
- (9) When there is no steer applied, neither steering clutch is actuated and the left and right steering clutch shafts are stationary. The two output sun gears receive drive from the output planet pinions which are being driven by the two output ring gears. The drive to each output sun gear is in the same direction and is transmitted back through a gear train to the side steering differential bevel gears. The design of the steering differential will not allow these bevel gears to rotate in the same direction. Therefore, the output sun gears are held stationary during no-steer.
- (10) The selection of left steer causes the left splined inner ring gear to be driven at the speed of the steering clutch shaft, see (4) above. The left inner ring gear transmits this drive (through the left steering clutch shaft, the pinion gear, and the spur gear) to the left steering bevel pinion. This bevel pinion turns the drive 90 degrees so that the drive flows (through the left side steering bevel gear, the left steering cross shaft, the left steering output pinion gear, and the left steering output gear) to the left output sun gear. The sun gear rotates



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Figure 22. Neutral-range power flow.

in a direction opposite to the left output ring gear; this results in a decreased rotational speed of the left output planet carrier.

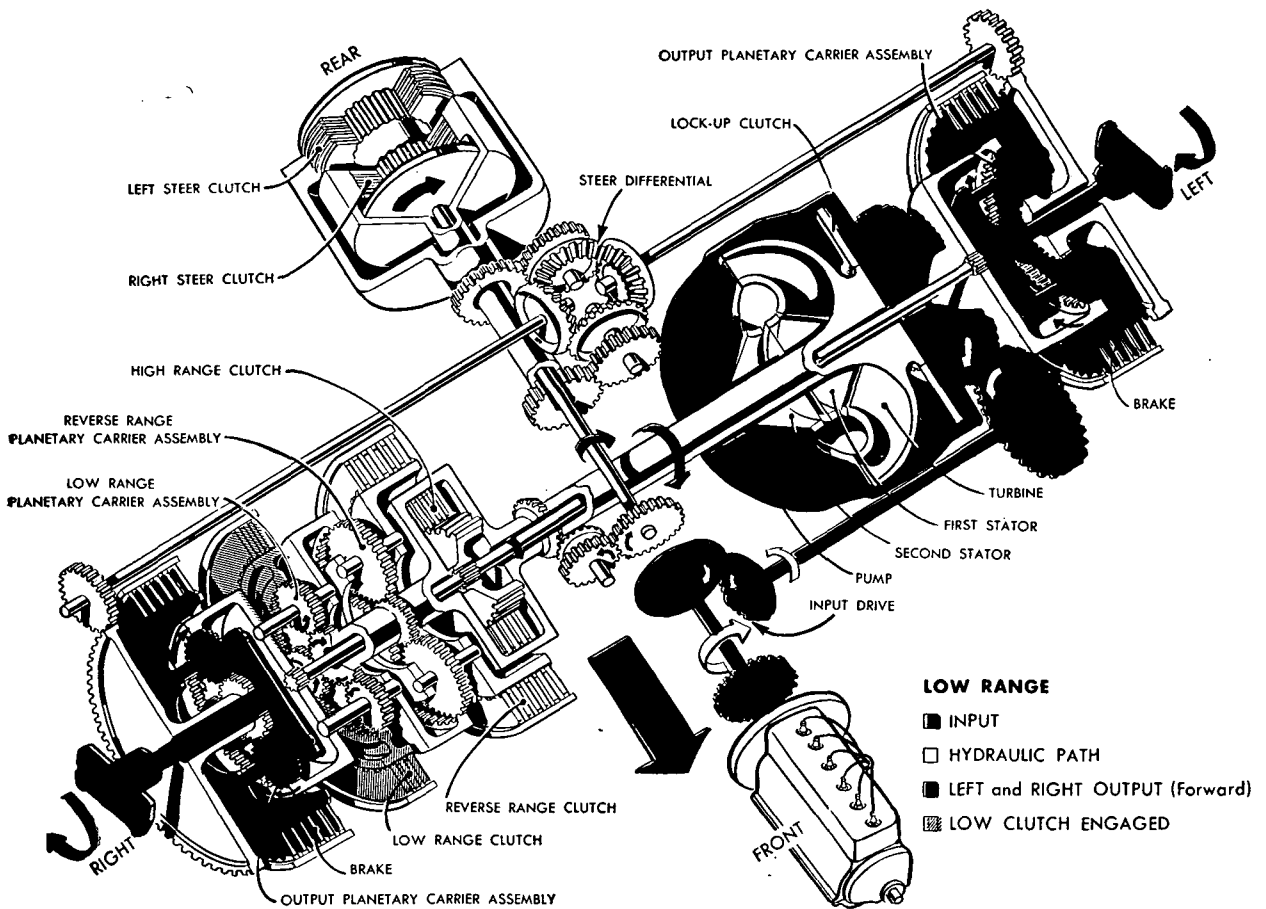
- (11) When the left steering bevel pinion turns the drive 90 degrees and drives the left side steering bevel gear, the bevel gear in turn drives the right steering bevel pinion. This causes the right bevel pinion to rotate in a direction opposite to the left steering bevel pinion. The right steering bevel pinion is free to move because the right steering clutch is not engaged. The right steering bevel pinion drives the right side steering bevel gear and the drive flows (through the right steering cross shaft, the right steering output pinion gear, and the right steering output gear) to the right output sun gear. Unlike the left output sun gear, the right output

sun gear rotates in the same direction as the right output ring gear (10 above). Therefore, the right output planet carrier rotates at an increased speed. The increase in rotational speed of the right output planet carrier is equal to the decrease in rotational speed of the left output planet carrier. This is true because the gear ratios from the steering differential to both output sun gears are the same.

- (12) The selection of right steer causes the right output planet carrier to decrease its rotational speed in proportion to the increase in rotational speed of the left output planet carrier.

d. RANGES.

- (1) *Neutral range* (fig. 22). In neutral range, the low-, high-, and reverse-range clutches are released. No driving power can be delivered to the output ring gears.

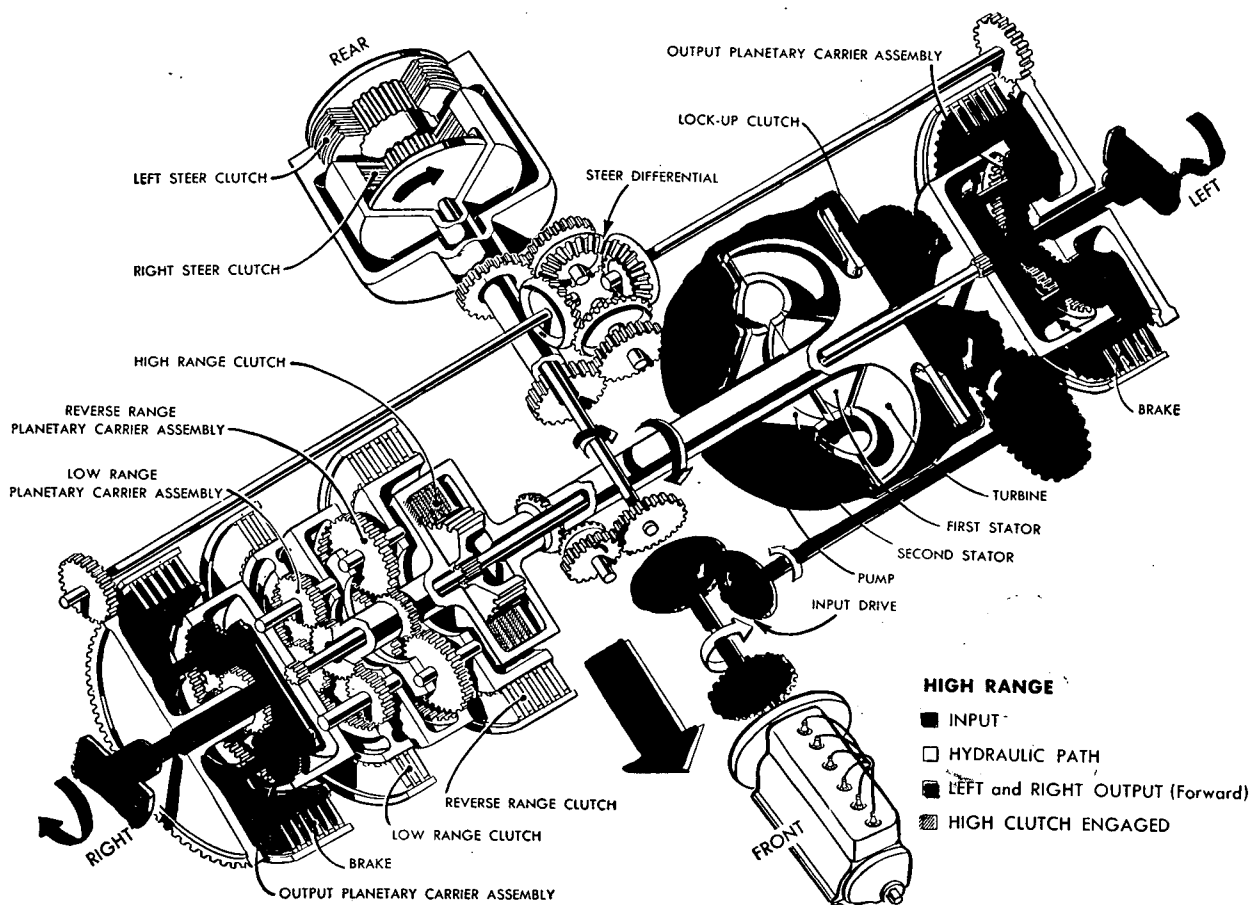


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Figure 23. Low-range power flow.

(2) *Low range* (fig. 23). The range control valve controls main oil pressure to the low-range clutch. When engaged, the clutch locks the low-range ring gear. The low-range sun gear, driven clockwise by hydraulic power from the converter-turbine, walks the low-range planet pinions around inside the low-range ring gear. The low-range planet carrier and

the right output ring gear, which are bolted together, are driven clockwise at reduced speed and increased torque. The cross-drive shaft, splined to the right output ring gear, transmits the drive to the left output ring gear. From the output ring gears, the drive goes through the planet pinions to the output planet carriers.

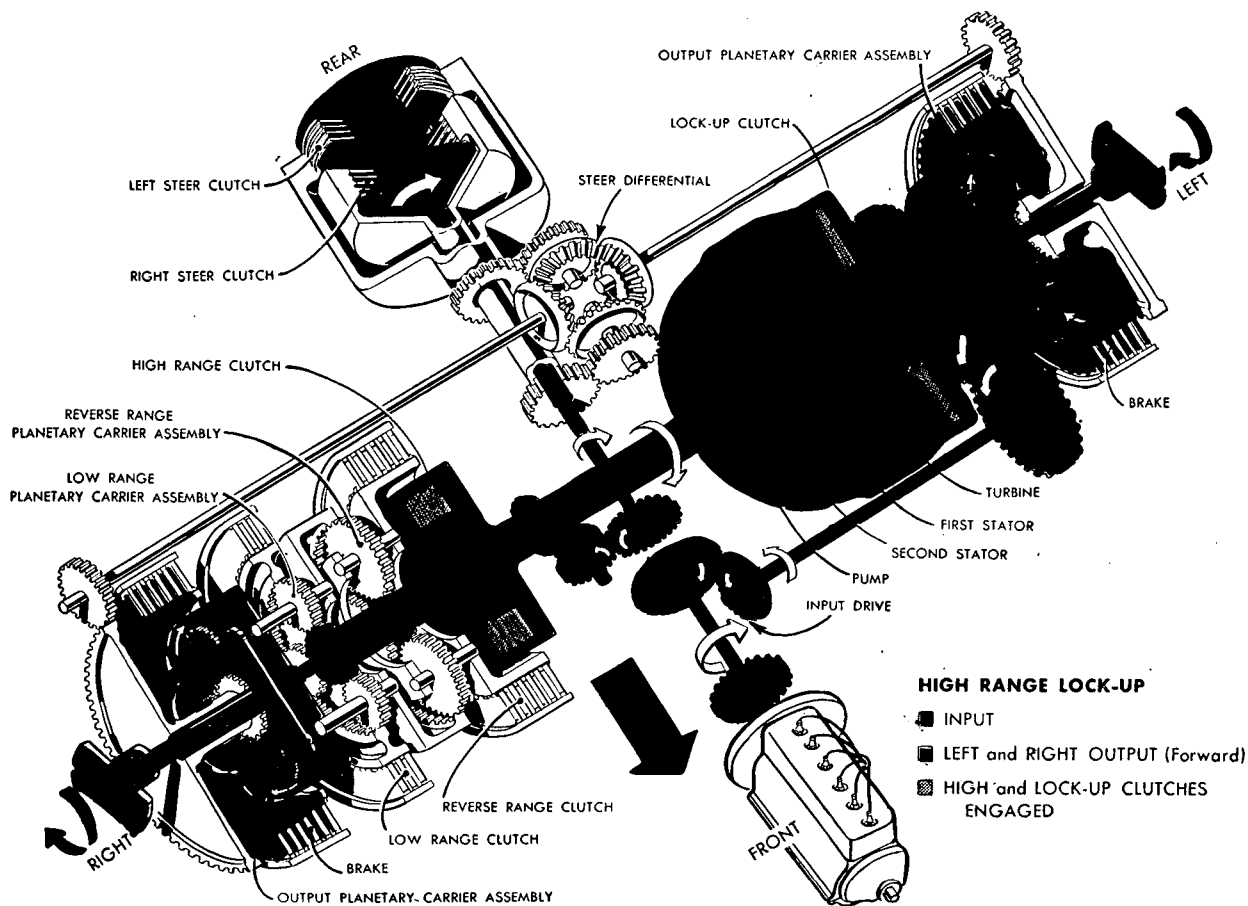


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Figure 24. High-range power flow.

(3) *High range* (fig. 24). The range control valve controls main oil pressure to the high-range clutch. When engaged, the high-range clutch locks together as a unit the high-range clutch housing, the clutch hub, and the cross-drive shaft, making

them all rotate at converter-turbine speed. Therefore, the hydraulic driving power is transmitted directly to the output ring gears, which in turn drive the output planet carriers.

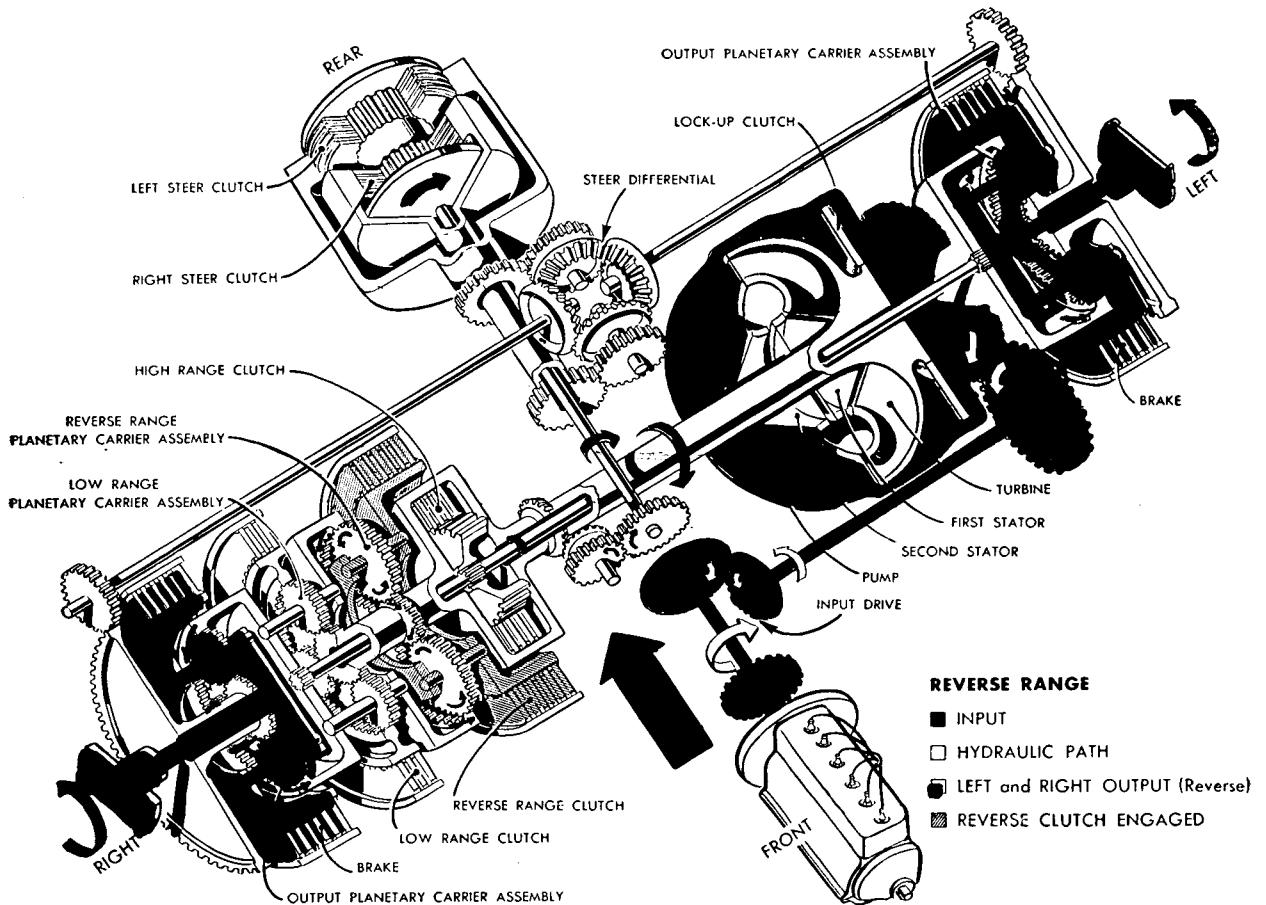


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Figure 25. High-range lock-up power flow.

(4) *High-range lock-up* (fig 25). When the transmission attains a speed of approximately 2,210 output rpm, converter lock-up occurs. Main oil pressure in the lock-up governor and the lock-up governor relay valve is released to engage the converter lock-up clutch. The clutch locks the turbine and pump

so that they rotate together as one unit, and no hydraulic torque conversion occurs. Direct mechanical drive is delivered from the transmission input through the high-range clutch to the transmission output. The converter goes out of lock-up at a speed of approximately 1,885 output rpm.



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Figure 26. Reverse-range power flow.

- (5) *Reverse range* (fig. 26). The reverse-range clutch is engaged by main oil pressure directed to it by the range control valve. The reverse-range clutch hub and the reverse-range planet carrier are held stationary. The reverse-range planet pinions are rotated counterclockwise on their stationary spindles by the reverse-range sun gear, which receives its drive from the converter output shaft.

This drive is transmitted to the reverse-range ring gear. The right output ring gear also rotates counterclockwise since it, as well as the reverse-range ring gear, is bolted to the low-range planet carrier. The cross-drive shaft joins the right and left output ring gears, causing both output ring gears and planet carriers to rotate in a reverse direction.

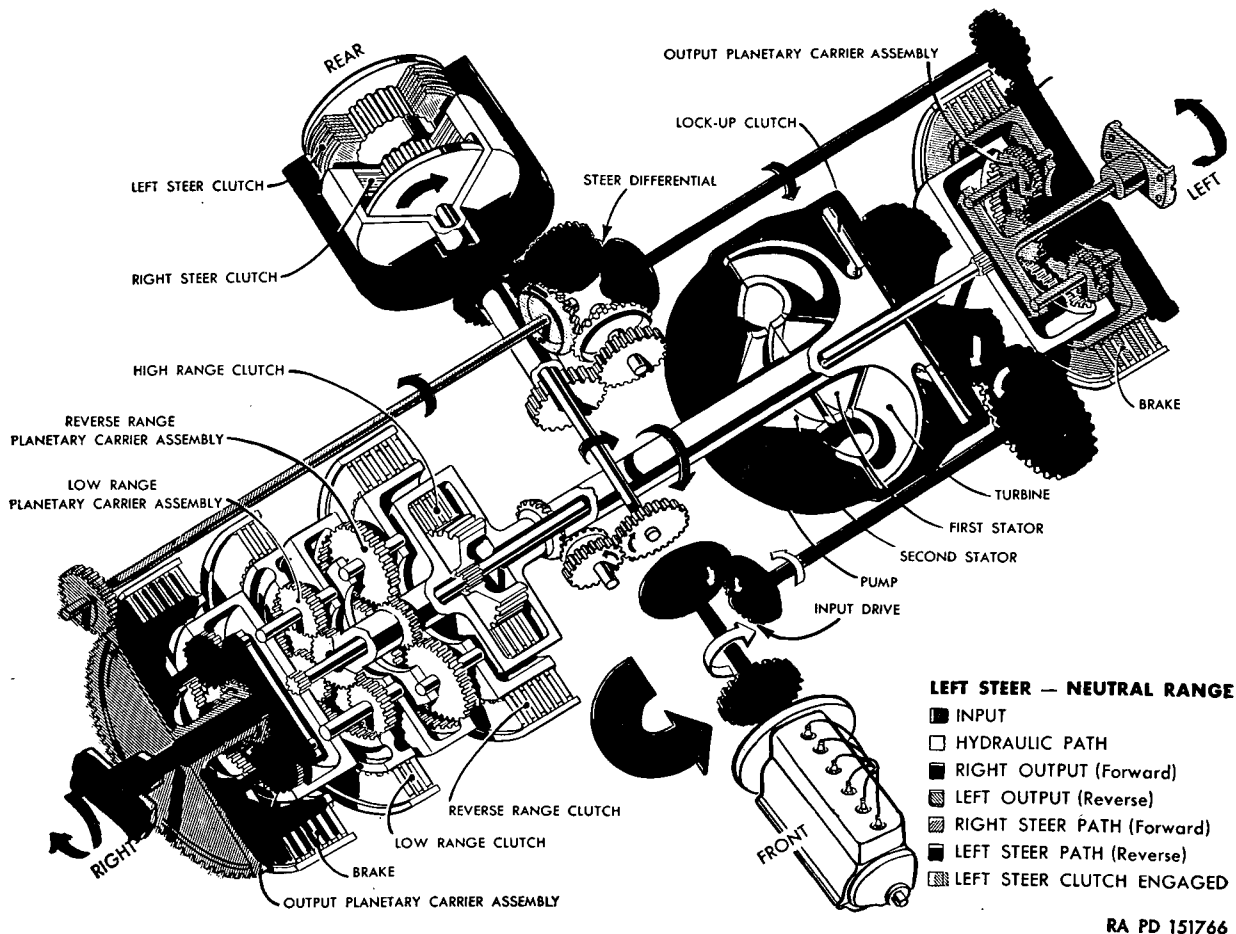
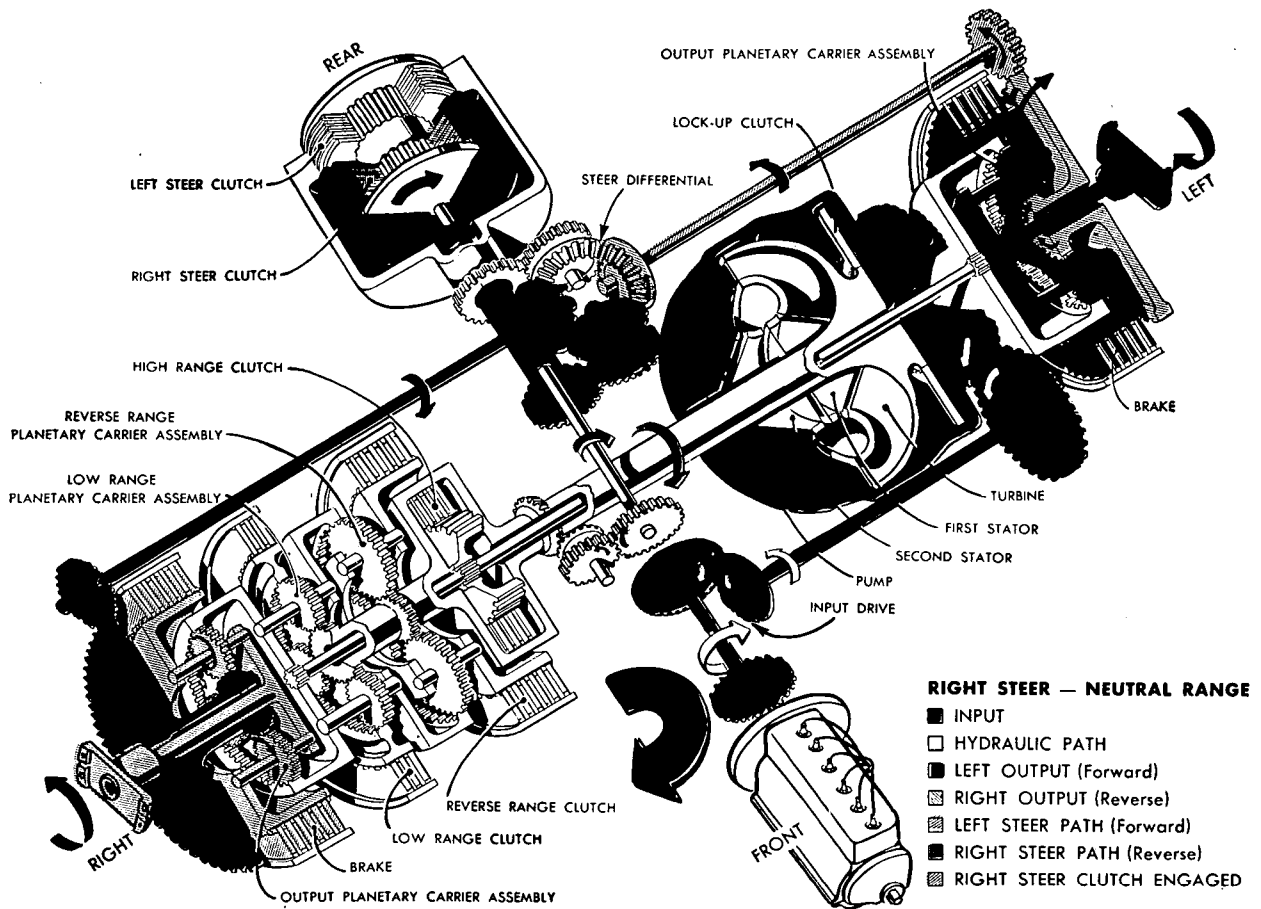


Figure 27. Left-steer neutral-range power flow.

e. STEERING.

- (1) *General.* Steering is effected through the steering drive power path (c above). In the following explanations, steering in the various ranges is described.
- (2) *Left steer in neutral range* (fig. 27). The low-, high-, and reverse-range clutches are disengaged. No driving power is being transmitted to the output ring gears. When the left steering valve is actuated, main oil pressure (150 psi) is directed to the left steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the left steering clutch engaged, hydraulic drive is trans-

ferred to the steering differential. The differential is so designed that a forward rotation is given to the right output sun gear while a reverse rotation is transmitted to the left output sun gear. The output ring gears cannot rotate in opposite directions because they are splined to the cross-drive shaft. Therefore, the output sun gears are the driving members in the output planetary systems, while the output ring gears are the reaction members. Since the right output planet carrier is driven forward by the right output sun gear and the left output planet carrier is driven on a reverse direction by the left output sun gear, the vehicle pivots to the left.



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Figure 28. Right-steer neutral-range power flow.

- (3) *Right steer in neutral range* (fig. 28). The low-, high-, and reverse-range clutches are disengaged. No driving power is being transmitted to the output ring gears. When the right steering valve is actuated, main oil pressure (150 psi) is directed to the right steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the right steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential is so designed that a forward rotation is given to the

left output sun gear while a reverse rotation is transmitted to the right output sun gear. The output ring gears cannot rotate in opposite directions because they are splined to the cross-drive shaft. Therefore, the output sun gears are the driving members in the output planetary system while the output ring gears are the reaction members. Since the left output planet carrier is driven forward by the left output sun gear and the right output planet carrier is driven in a reverse direction by the right output sun gear, the vehicle pivots to the right.

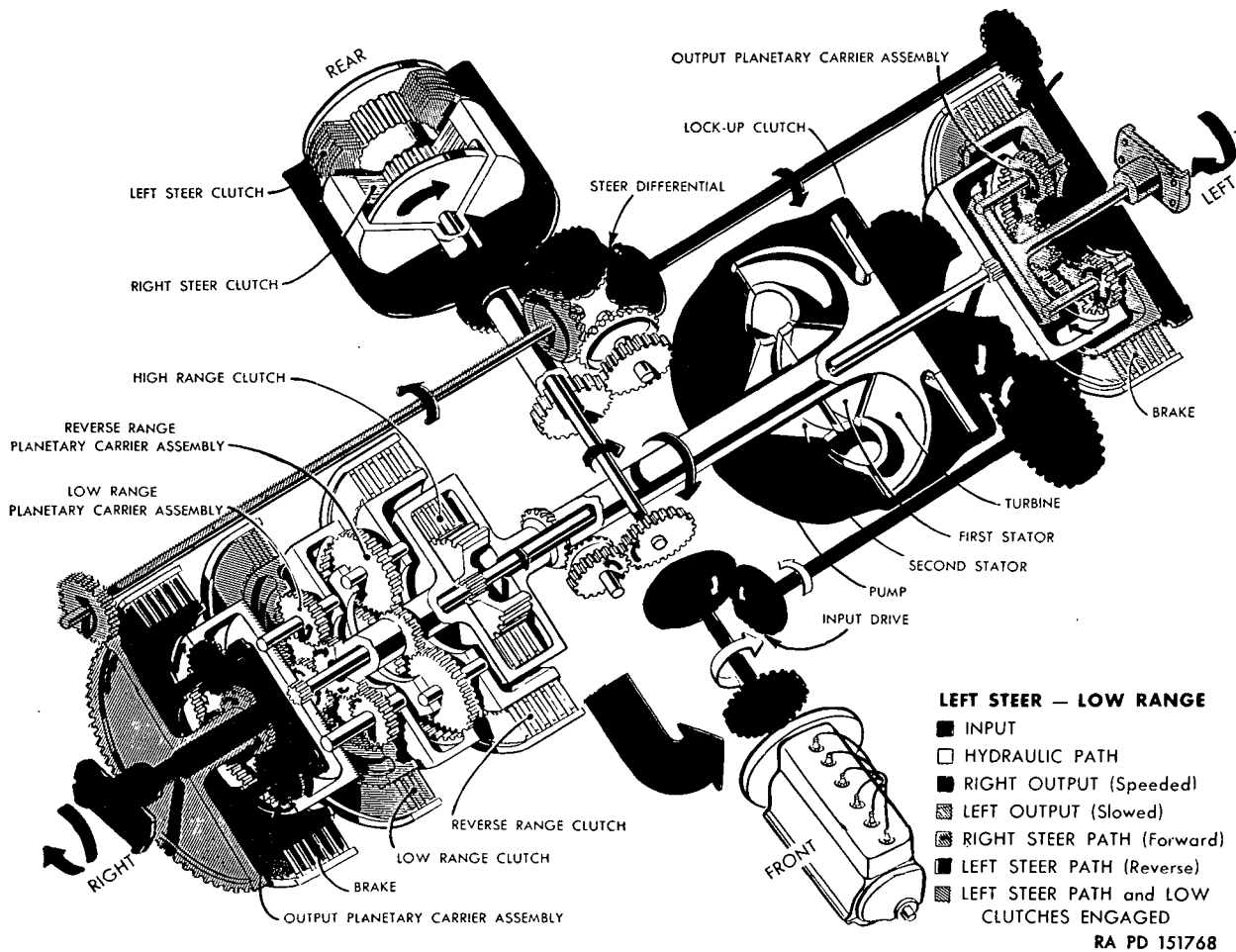
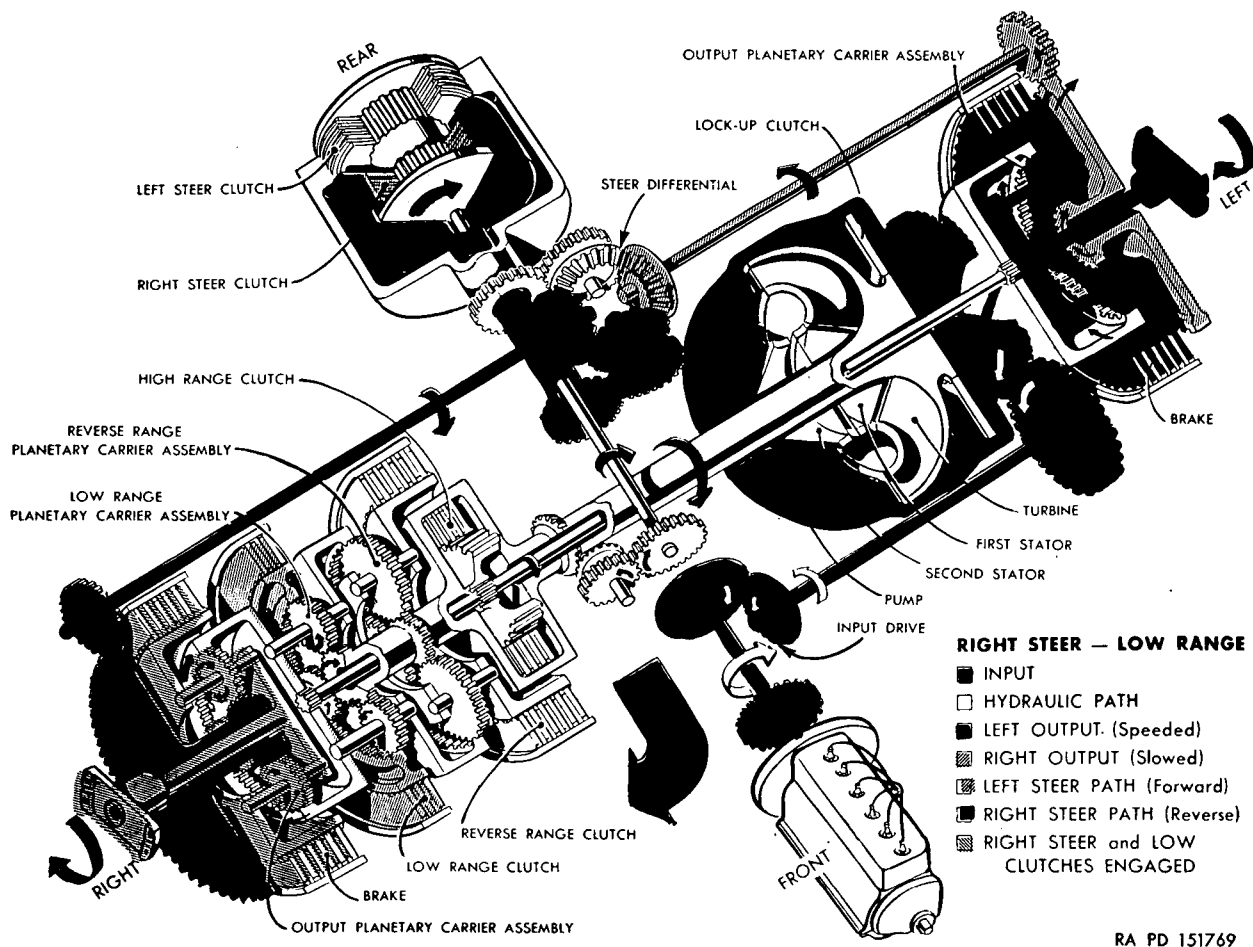


Figure 29. Left-steer low-range power flow.

(4) *Left steer in low range* (fig. 29). In low range, the output ring gears are driving the output planet carriers forward. When the left steering valve is actuated, main oil pressure (150 psi) is directed to the left steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the left steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential is so designed that a forward

rotation is given to the right output sun gear while a reverse rotation is transmitted to the left output sun gear. Since both output ring gears are rotating forward, the forward rotation of the right output sun gear will increase the drive on the right output planet carrier. The reverse rotation of the left output sun gear decreases the drive on the left output planet carrier. With the right output speeded up and the left slowed down, the vehicle steers to the left.

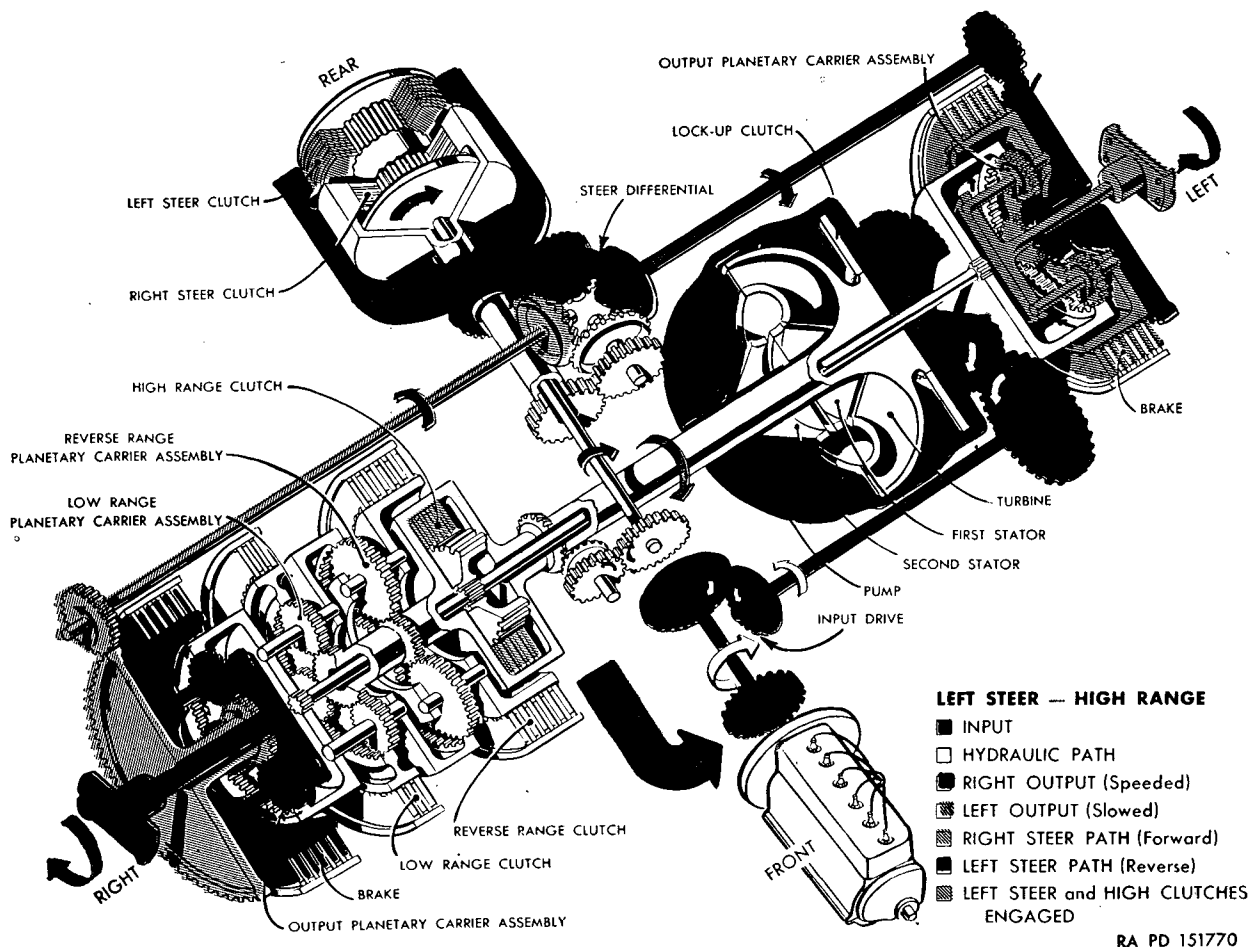


RA PD 151769

Figure 30. Right-steer low-range power flow.

(5) *Right steer in low range* (fig. 30). In low range, the output ring gears are driving the output planet carriers forward. When the right steering valve is actuated, main oil pressure (150 psi) is directed to the right steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the right steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential is so designed that a forward rota-

tion is given to the left output sun gear while a reverse rotation is transmitted to the right output sun gear. Since both output ring gears are rotating forward, the forward rotation of the left output sun gear will increase the drive on the left output planet carrier. The reverse rotation of the right output sun gear decreases the drive on the right output planet carrier. With the left output speeded up and the right slowed down, the vehicle steers to the right.

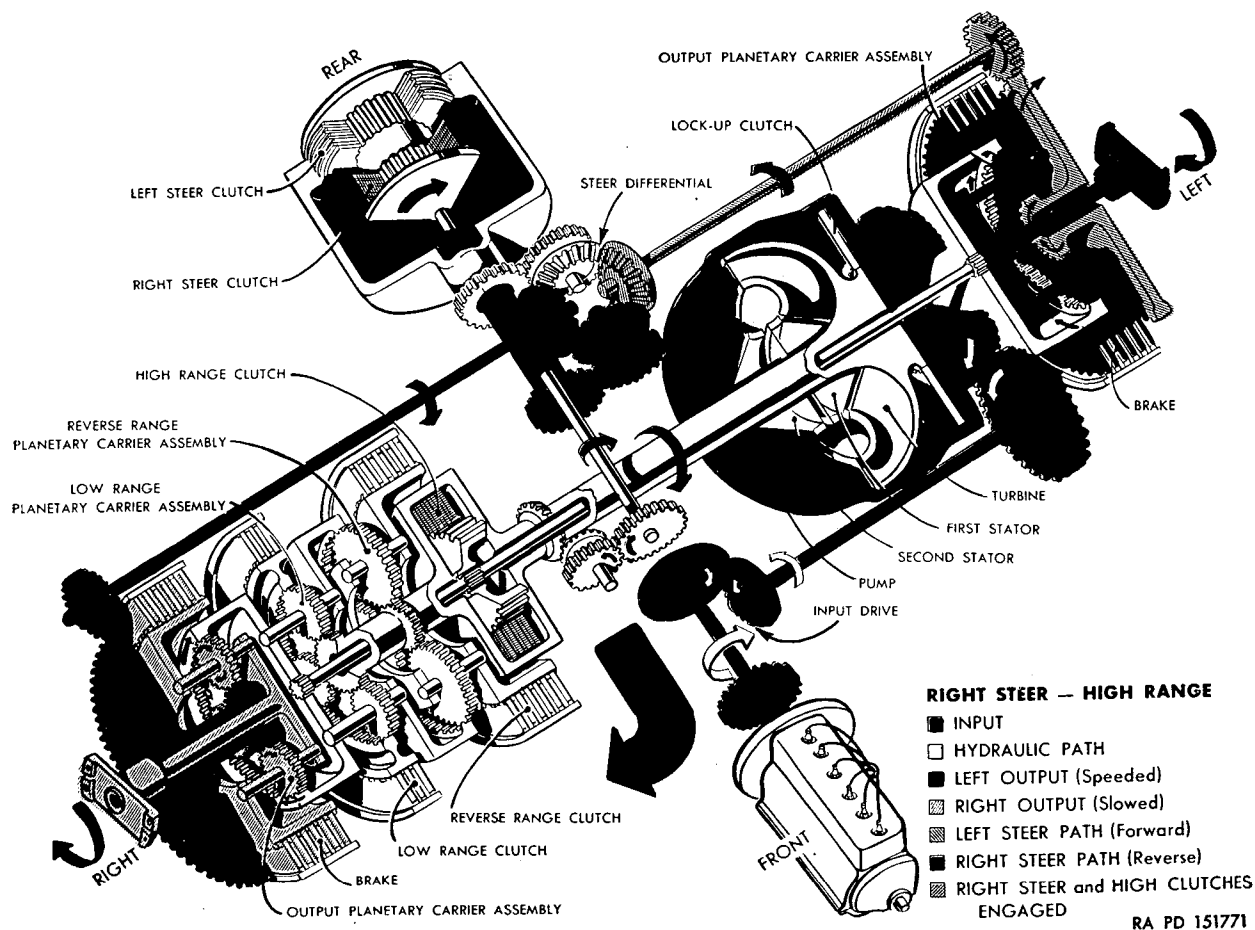


RA PD 151770

Figure 31. Left-steer high-range power flow.

(6) *Left steer in high range* (fig. 31). In high range, the output ring gears are driving the output planet carriers forward. When the left steering valve is actuated, main oil pressure (150 psi) is directed to the left steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the left steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential is so designed that a forward rotation

is given to the right output sun gear while a reverse rotation is transmitted to the left output sun gear. Since both output ring gears are rotating forward, the forward rotation of the right output sun gear will increase the drive on the right output planet carrier. The reverse rotation of the left output sun gear decreases the drive on the left output planet carrier. With the right output speeded up and the left output slowed down, the vehicle steers to the left.

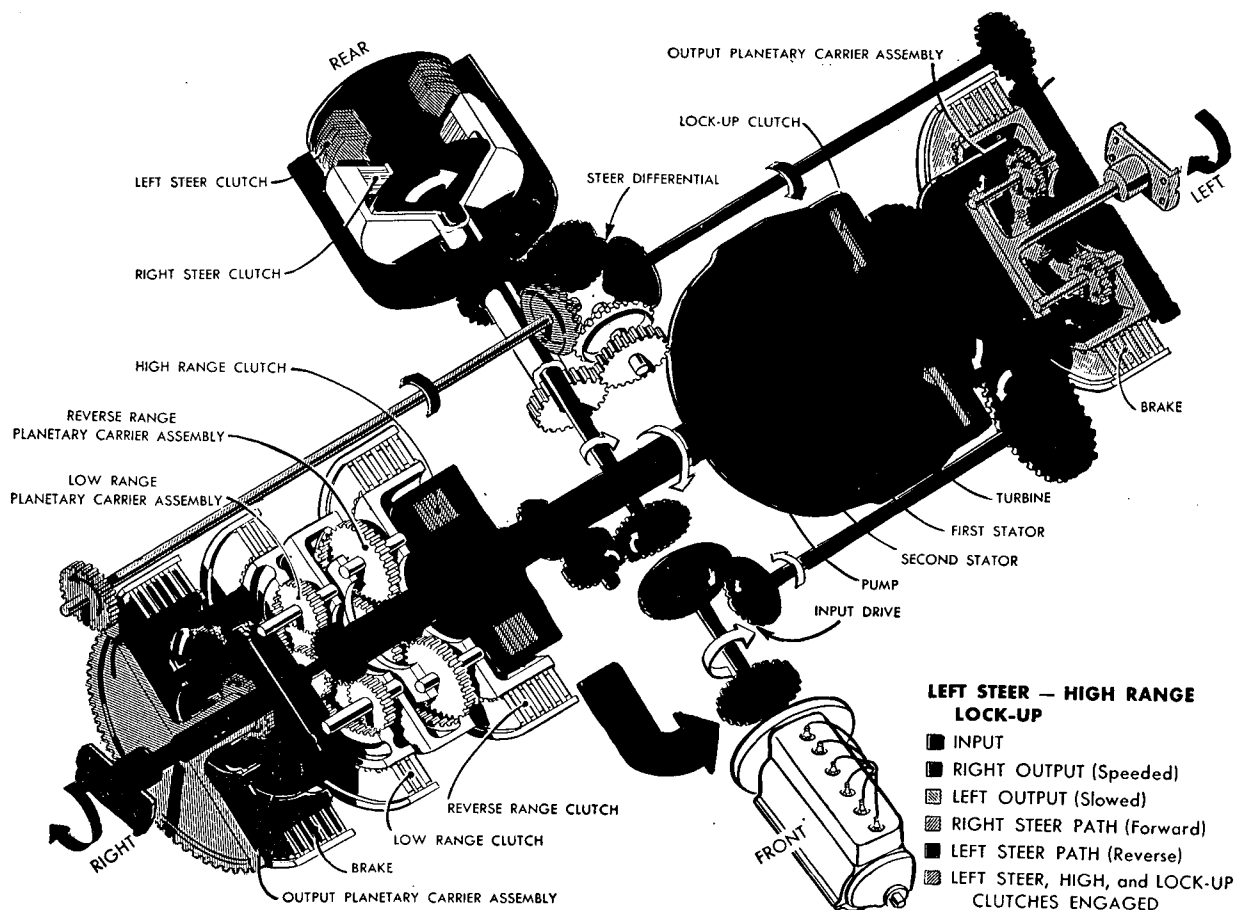


RA PD 151771

Figure 32. Right-steer high-range power flow.

(7) *Right steer in high range* (fig. 32). In high range, the output ring gears are driving the output planet carriers forward. When the right steering valve is actuated, main oil pressure (150 psi) is directed to the right steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the right steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential is so designed that a forward rotation

is given to the left output sun gear while a reverse rotation is transmitted to the right output sun gear. Since both output ring gears are rotating forward, the forward rotation of the left output sun gear will increase the drive on the left output planet carrier. The reverse rotation of the right output sun gear decreases the drive on the right output planet carrier. With the left output speeded up and the right output slowed down, the vehicle steers to the right.



RA PD 151772

Figure 33. Lock-up left-steer high-range power flow.

(8) *Left steer in high-range lock-up* (fig. 33). In high range lock-up, the output ring gears are driving the output planet carriers forward. When the left steering valve is actuated, main oil pressure (150 psi) is directed to the left steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the left steering clutch engaged, mechanical drive is transferred to the steering differential. Due to the steering differential design, a forward rotation is given to

the right output sun gear while a reverse rotation is transmitted to the left output sun gear. Since both output ring gears are rotating forward, the forward rotation of the right output sun gear will increase the drive on the right output planet carrier. The reverse rotation of the left output sun gear decreases the drive on the left output planet carrier. With the right output speeded up and the left output slowed down, the vehicle steers to the left.

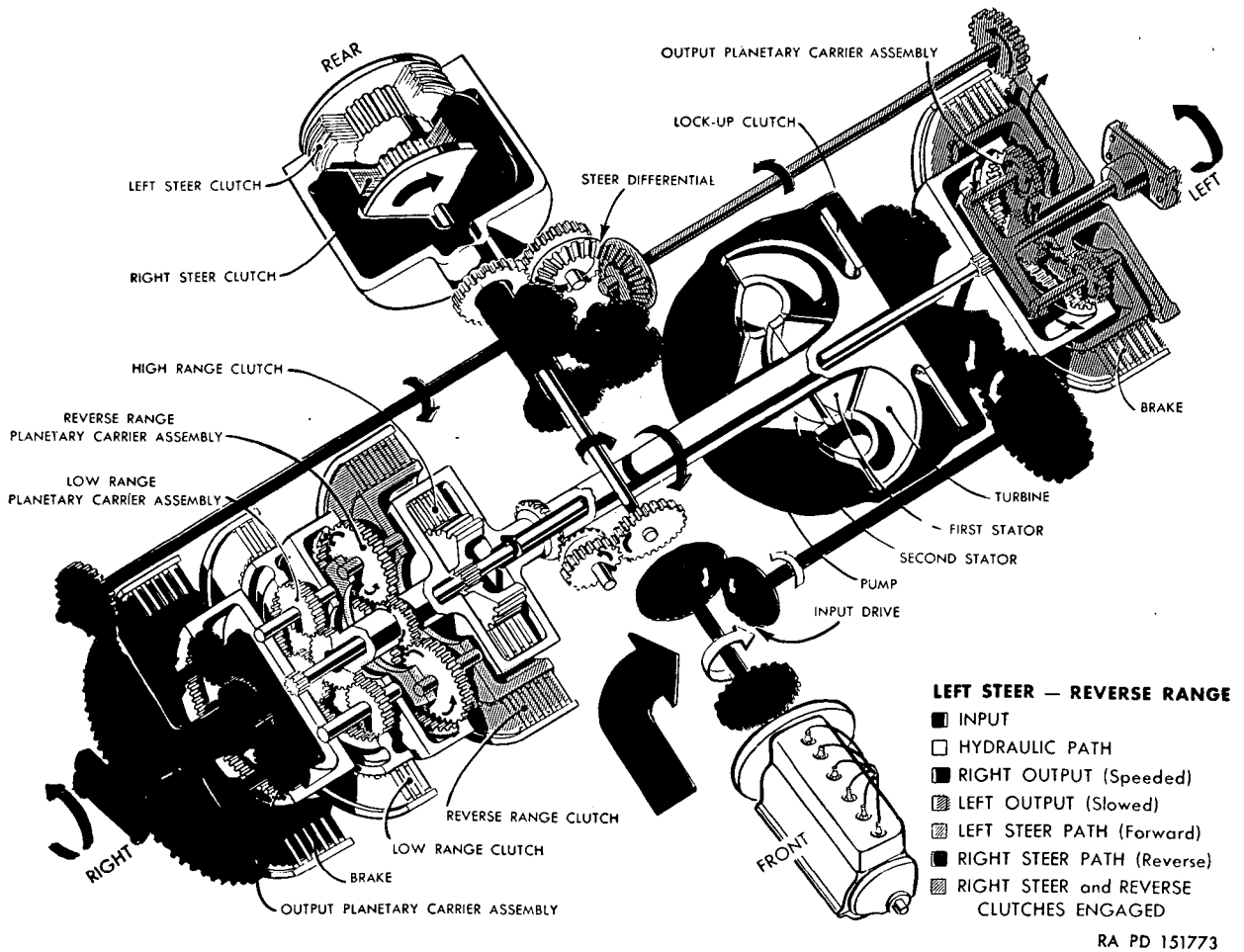


Figure 34. Left-steer reverse-range power flow.

(9) *Left steer in reverse range* (fig. 34). In reverse range, the output ring gears are driving the output planet carriers in a reverse direction. Therefore, it is necessary to move the steering control lever to the right in order to steer to the left. When the right steering valve is actuated, main oil pressure (150 psi) is directed to the right steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the right steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential

is so designed that a forward rotation is given to the left output sun gear while a reverse rotation is transmitted to the right output sun gear. Since both output ring gears are rotating in a reverse direction, the forward rotation of the left output sun gear will decrease the drive on the left output planet carrier. The reverse rotation of the right output sun gear increases the drive on the right output planet carrier. With the vehicle moving in a reverse direction, the left output slowed down, and the right output speeded up, the vehicle steers to the left.

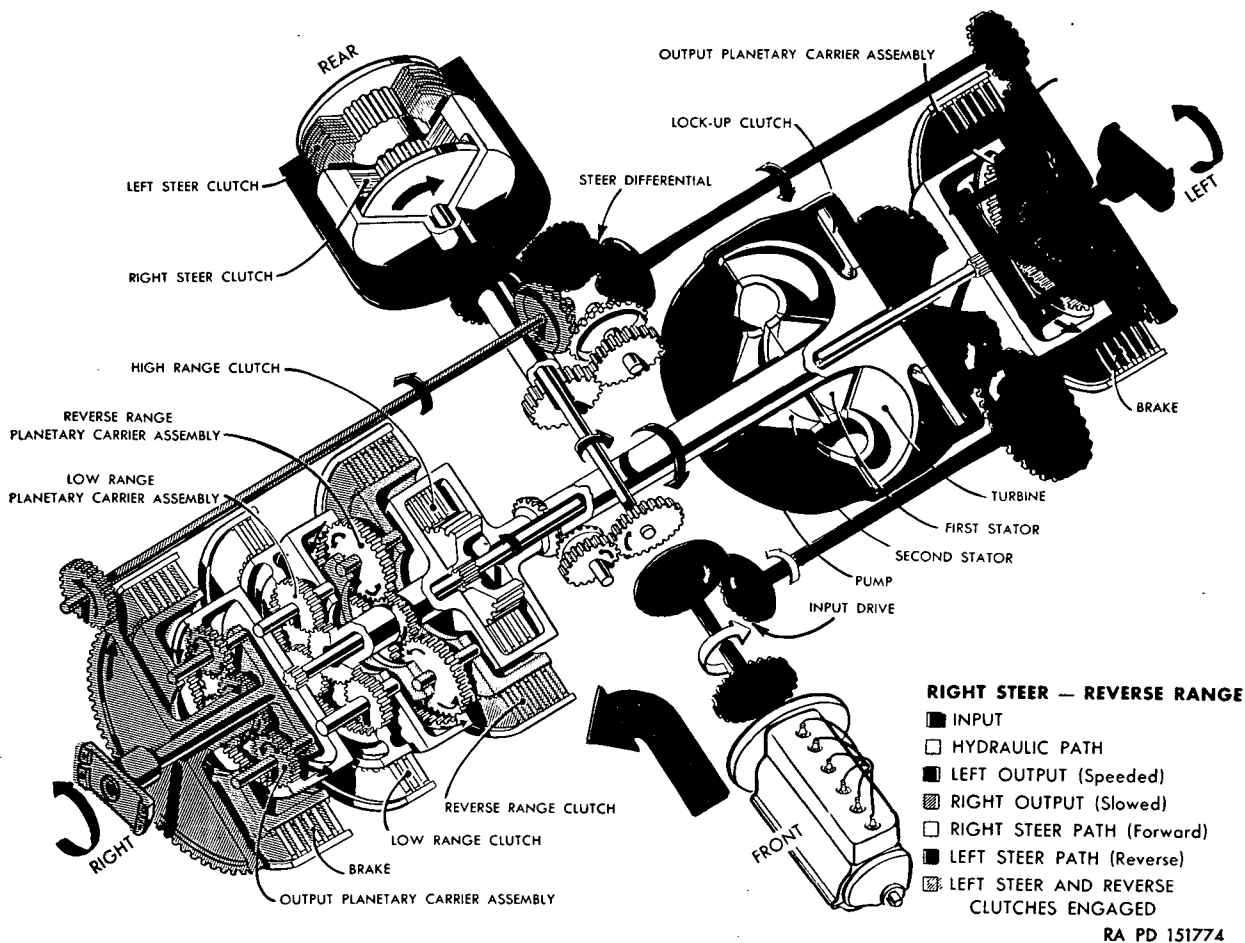


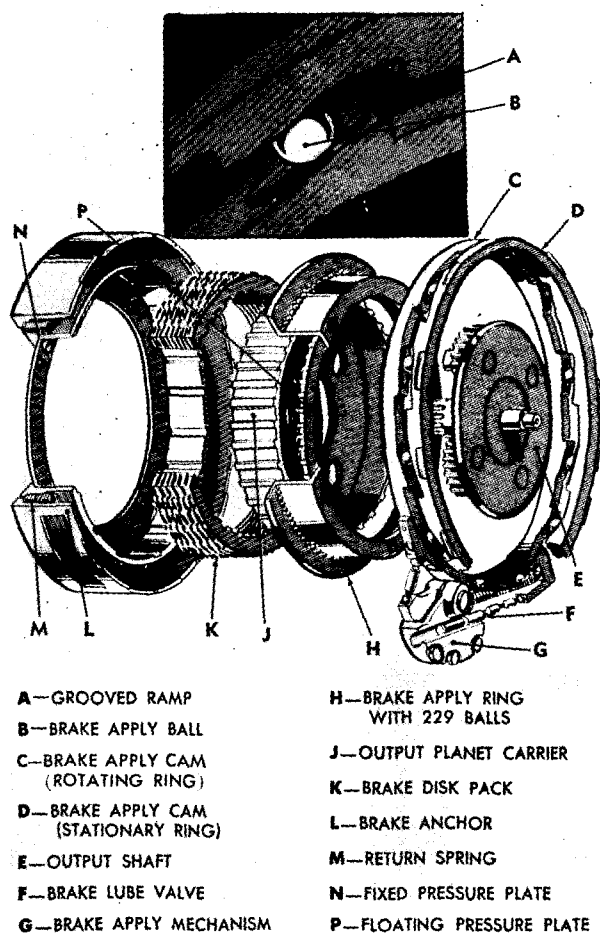
Figure 35. Right-steer reverse-range power flow.

(10) *Right steer in reverse range* (fig. 35). In reverse range, the output ring gears are driving the output planet carriers in a reverse direction. Therefore, it is necessary to move the steering control lever to the left in order to steer to the right. When the left steering valve is actuated, main oil pressure (150 psi) is directed to the left steering clutch piston, engaging the clutch. The clutch receives pressure proportional to the amount of steer applied. With the left steering clutch engaged, hydraulic drive is transferred to the steering differential. The differential

is so designed that a forward rotation is given to the right output sun gear while a reverse rotation is transmitted to the left output sun gear. Since both output ring gears are rotating in a reverse direction, the forward rotation of the right output sun gear will decrease the drive on the right output planet carrier. The reverse rotation of the left output sun gear increases the drive on the left output planet carrier. With the vehicle moving in a reverse direction, the right output slowed, and the left output speeded up, the vehicle steers to the right.

20. Braking System

a. GENERAL. Each of the two end plate assemblies contains an oil-cooled friction disk brake assembly (fig. 36). This assembly consists of six internally splined (steel) disks which spline onto and rotate with the output planet carrier. Alternated with these are five externally splined (bronze) disks which spline into the brake anchor. The brake anchor, bolted to the end plate, is stationary, and has fixed to it the brake apply cam stationary ring. The brake apply cam rotating ring is connected with the brake apply mechanism. The brake fixed pressure plate is bolted to the brake anchor and the brake floating pressure plate is bolted to the brake apply ring. When the brake disk pack is compressed, the output planet carrier is held stationary. The carrier is bolted to the output shaft and flange, so the vehicle is braked. Separate brake apply levers control each brake.



RA PD 151775

Figure 36. Brake schematic.

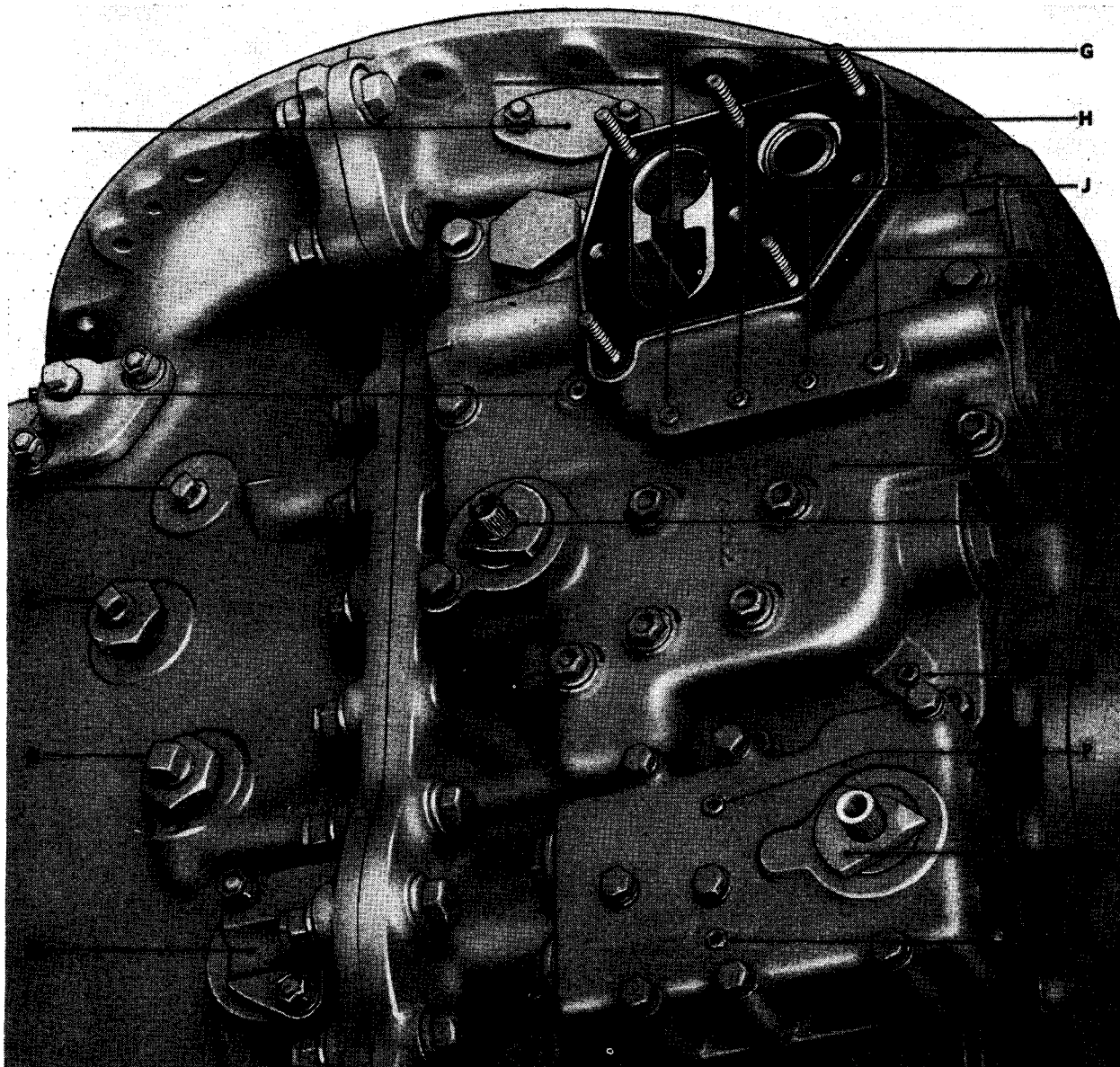
These brake apply levers are linked to a single brake pedal in the driver's compartment thus assuring simultaneous application of the brakes.

b. OPERATION. The right and left brakes function at the same time and in the same manner, so the following applies to both. Through the mechanical linkage and a brake apply lever, the brake apply shaft is rotated. This movement is transmitted to the brake apply cam rotating ring. As this ring rotates, the 12 brake apply balls are rolled up grooved ramps. These ramps are located between the brake apply cam rotating ring and the brake apply cam stationary ring. When the balls force the rings apart, one of the rings must move outward. The stationary ring is tabbed and fitted into the brake anchor so that it cannot move; therefore, the rotating ring is moved. This movement compresses the disk pack through the brake apply ring, applying the brake. When the brake is released, the brake apply mechanism rotates the rotating ring back to its original position and the 10 brake-plate release springs push the brake apply ring to its released position, releasing the entire disk pack.

21. Tabulated Data

a. TRANSMISSION.

Type	cross-drive.
Weight, dry (approximate)	2,041 pounds.
Length (front to rear)	34 $\frac{1}{2}$ inches.
Height (top to bottom)	33 $\frac{1}{2}$ inches.
Width (side to side)	44 $\frac{1}{4}$ inches.
Suspension	3 point (engine and 2 mounting pads).
Drive ranges	low, high, and reverse.
Shift and steering control:	
External	mechanical.
Internal	hydraulic.
Clutches:	
Engaged by	oil pressure.
Released by	spring pressure.
Hydraulic torque converter	single stage, poly-phase, 4 element, with a governor operated lock-up clutch.
Brakes:	
Quantity	2.
Type	wet, friction disk.
Application	mechanical.
Cooling	oil.
Oil pumps:	
Quantity	6.
Type	4 spur gear, 1 gerotor, and 1 paddle wheel (special).



- | | |
|--|---------------------------------------|
| A—STEERING-DIFFERENTIAL INSPECTION PLATE | J—MAIN-OIL PRESSURE CHECK POINT |
| B—CONVERTER "IN" TEMPERATURE CHECK POINT | K—REVERSE-RANGE PRESSURE CHECK POINT |
| C—LUBRICATION-PRESSURE CHECK POINT | L—CONTROL VALVE ASSEMBLY |
| D—CONVERTER "IN" PRESSURE CHECK POINT | M—SHIFTING QUADRANT |
| E—LUBRICATION-PRESSURE CHECK POINT | N—LIMIT-PUMP PRESSURE CHECK POINT |
| F—ENGINE TIMING CHECK POINT | P—LEFT-STEERING PRESSURE CHECK POINT |
| G—HIGH-RANGE PRESSURE CHECK POINT | Q—STEERING QUADRANT |
| H—LOW-RANGE PRESSURE CHECK POINT | R—RIGHT-STEERING PRESSURE CHECK POINT |
| S—PRESSURE-STEER VALVE ASSEMBLY | |

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Figure 37. Control valve and steering valve, pressure check points.

Converter torque multiplication at stall.	4 to 1.	Fan drive:	
Oil capacity	16 gal to fill, 11 gal to refill.	Quantity	1.
Oil grade	USA Spec. 2-104 (SAE-10).	Rotation	clockwise.
Oil filter:		Ratio	0.663 engine speed.
Quantity	3.	Torque available:	
Type	air maze.	CD-500-3 (max. at "LOW" stall).	9,250 lb-ft.
Oil cooled by	air cooled radiators.	CD-500-3 (max. at "HIGH" stall).	2,550 lb-ft.
		CD-500-4 (max. at "LOW" stall).	9,000 lb-ft.
		CD-500-4 (max. at "HIGH" stall).	2,400 lb-ft.

b. HYDRAULIC CONTROL PRESSURES.

Pressure *	Location	psi	
		Minimum	Maximum
Brake coolant	Rear of left housing above input pressure pump assembly (fig. 2).	Nonregulated to 100 over main pressure.	limited
Governor	Left end cover on governor body cover (fig 4)	Out of lock-up 98.9.	In lock-up 118.
Lock-up clutch	Left end cover near top split line (fig. 4)	135	165
Converter "IN"	Left housing (D of fig. 37)	72	88
Lubrication	Left housing (C of fig. 37)	27.5	32.5
High-range	Control valve body (G of fig. 37)	135	165
Low-range	Control valve body (H of fig. 37)	135	165
Reverse-range	Control valve body (K of fig. 37)	135	165
Main oil	Control valve body (J of fig. 37)	135	165
Left steering	Steering control valve body (P of fig. 37)		165
Right steering	Steering control valve body (R of fig. 37)		165

*Readings with engine speed of approximately 1,000 rpm and oil at normal operating temperature.

Section II. DISASSEMBLY OF TRANSMISSION INTO SUBASSEMBLIES

22. Preliminary Instructions

a. GENERAL.

- (1) Proper equipment must be available before the disassembly is started. This equipment includes a chain hoist of at least 1½-ton capacity, proper hand tools and special tools, receptacles for small parts, wiping cloths, and a transmission assembly table. Many units of the transmission are too heavy to handle by hand. Special slings are provided, and should be used with these heavy units. Where ordinary hand tools are inadequate, special tools are provided (par. 8).
- (2) All safety devices, such as locking wire, cotter pins, and jam nuts must be disposed of as they are removed from the transmission. They must not be used a second time.

- (3) When handling transmission parts, care must be exercised to avoid damaging them. Nicks, scratches, or dents caused by careless handling of parts may cause subsequent transmission failure.
- (4) Replace all gaskets and defective seal rings. Silicone, neoprene, and metal seal rings must be handled with care during disassembly to prevent unnecessary damage to them.

b. SEPARATION OF TRANSMISSION FROM REMAINDER OF VEHICLE POWER PLANT.

- (1) Place the power plant on a stand or block with suitable blocks or rests to support the unit. Remove the power pack sling (41-S-3830-700) and install the transmission sling (41-S-3832-165) on the transmission. Take up the slack. Disconnect the two sending units on transmission.

- (2) Disconnect the brake rod at the stabilizer bar. Disconnect the transmission vent hose. Disconnect the oil cooler lines. Remove 24 nuts from the studs at attaching flange. Gradually work the transmission away from the engine and take the transmission to a suitable bench or stand.

23. Disassembly of Transmission

a. PREPARATION OF TRANSMISSION FOR DISASSEMBLY. Position the hoist over the transmission. Attach the lifting sling (41-S-3832-165) to the transmission lifting eyes and raise the transmission (fig. 38). Remove both magnetic drain plugs from the bottom of the transmission, using a $\frac{1}{2}$ -inch break-over bar (fig. 39). Allow the transmission oil to drain completely. Install and tighten the drain plugs. Remove the input shaft coupling (fig. 40). Lower the transmission onto the assembly table and level it with wooden blocks (fig. 41).

b. REMOVAL OF CONVERTER-OIL-FILTER ASSEMBLY. Use a $\frac{5}{16}$ -inch wrench to remove seven jam nuts, nuts, and washers from the converter-oil-filter-body studs. Remove the filter body assembly and gasket (fig. 42).

c. REMOVAL OF THE STEERING CLUTCH PACK ASSEMBLY. Remove the six bolts from the steering-clutch-coolant pump, using a $\frac{1}{2}$ -inch wrench. Pull the pump and "O" ring gasket from the coolant-pump manifold (fig. 43). Using a $\frac{1}{2}$ -inch wrench, remove the six bolts and washers from the center of the coolant-pump manifold, and the three bolts and washers from the lower right end of the manifold. Remove the coolant pump manifold and the two gaskets (fig. 44). Remove 18 jam nuts, nuts, and washers, from the transmission rear cover, using a $\frac{1}{2}$ -inch wrench. Separate the transmission rear cover from the main housings with the aid of two $\frac{5}{16}$ -inch jack screws (fig. 45) and remove the cover (fig. 46). Using pliers (41-P-1992-36), remove the large snap ring which retains the steering clutch-pack-assembly in the left-steering drum (fig. 47). Pull the steering clutch pack out of the drum (fig. 48).

d. REMOVAL OF MISCELLANEOUS ASSEMBLIES FROM REAR OF TRANSMISSION.

- (1) *Main oil filter assembly.* Remove three bolts and washers from the filter, using a $\frac{5}{16}$ -inch wrench. Separate the filter from

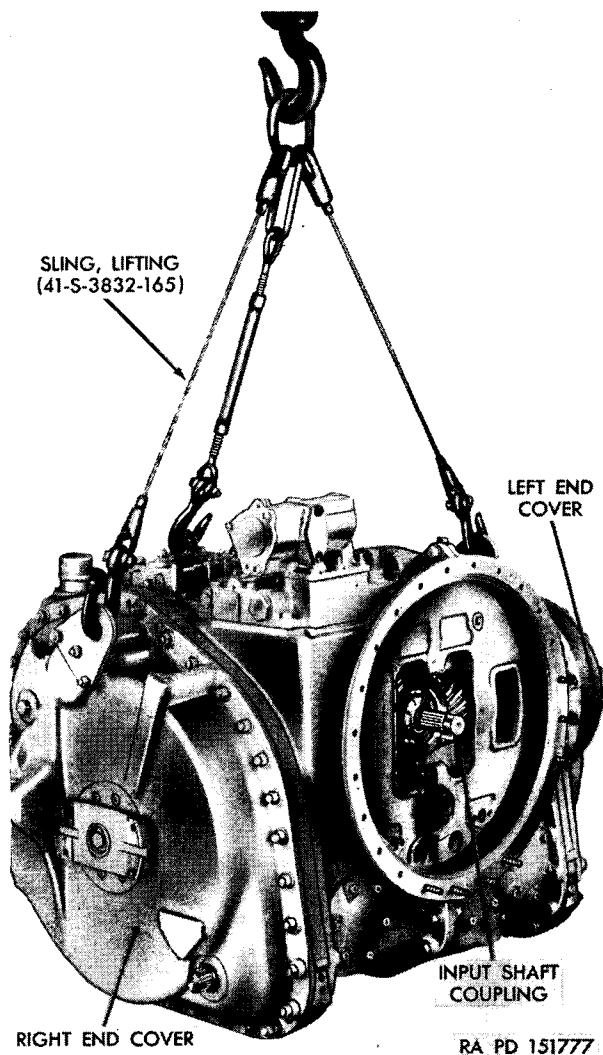


Figure 38. Lifting transmission.

the left housing by using two of the filter bolts as jack screws (fig. 49). Remove the filter assembly (fig. 50).

- (2) *Pressure control valve assembly.* Remove nine bolts and washers, using a $\frac{1}{2}$ -inch wrench, from the valve body. Separate the valve body from the left housing, using two of the valve body bolts as jack screws (fig. 51). Remove the valve assembly and gasket (fig. 52). Keep the two jumper tubes with the valve assembly.
- (3) *Input pressure pump.* Using external snap ring pliers, remove the snap ring from the jumper tube (fig. 53). Push

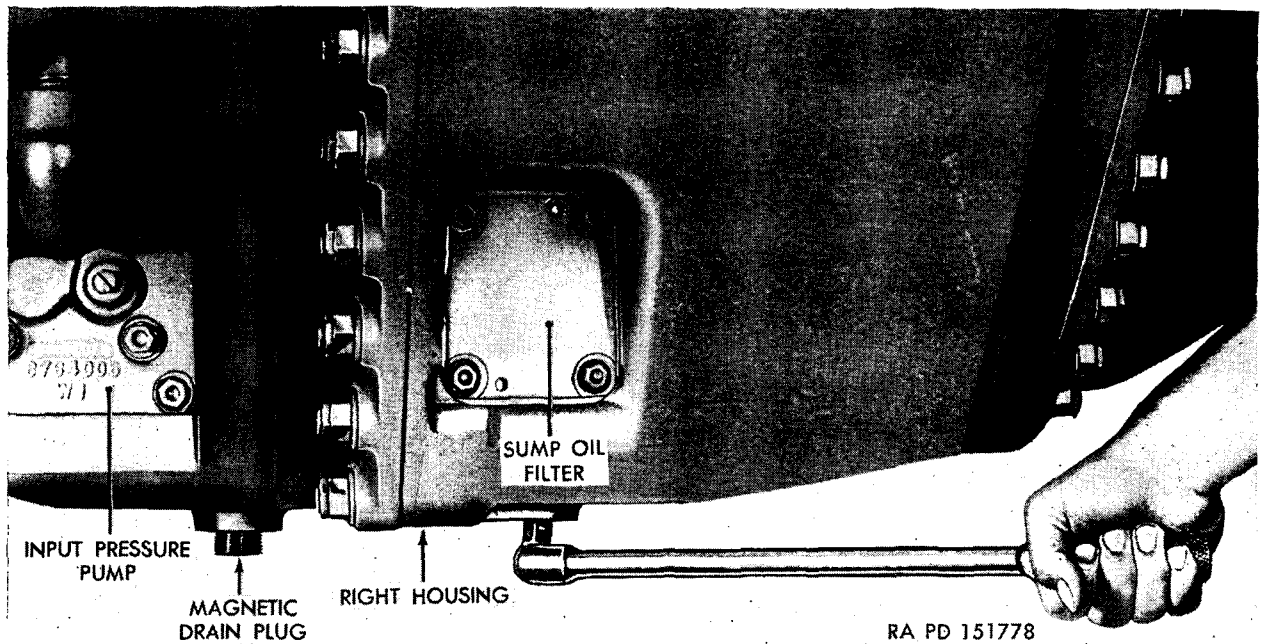


Figure 39. Removing magnetic drain plugs.

the jumper tube up into the housing using a screwdriver (fig. 54). Remove four bolts from the outer edge of the pump, using a $\frac{1}{2}$ -inch socket. Remove the pump assembly (fig. 55).

Note. The jumper tube, snap ring, four "O" ring gaskets, and the drive shaft-to-pump coupling should be kept with the pump assembly. Remove the input-pressure-pump-drive shaft (fig. 56).

- (4) *Sump oil filter.* Remove four bolts and washers, using a $\frac{1}{2}$ -inch socket, from the filter. Separate the filter assembly from the right housing, using two of the filter bolts as jack screws (fig. 57). Remove the filter assembly (fig. 58).

e. REMOVAL OF LEFT END COVER ASSEMBLY.

- (1) Using a $\frac{1}{2}$ -inch wrench, remove the three bolts and washers from the brake-adjusting cover. Remove the brake-adjusting cover from the left end cover.
- (2) Remove the locking wire from the left-output-flange-retainer nut. Install a wooden block between the output flange and the end cover to keep the flange from rotating when a wrench is applied to the flange-retainer nut. Using a $\frac{3}{8}$ -inch socket, loosen but do not remove the flange-retainer nut (fig. 59).

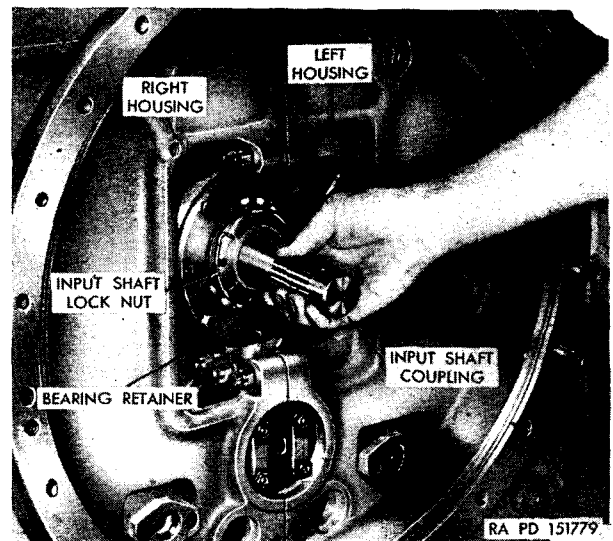


Figure 40. Removing or installing input shaft coupling.

- (3) Remove the 38 jam nuts, nuts, and washers from the end cover, using a $\frac{3}{4}$ -inch wrench. Remove the snap ring from the brake-apply shaft. Remove the brake-apply arm from the shaft.
- (4) Attach the hoist to the end cover lifting eye. Separate the left end cover from the left end plate with the aid of three puller screws (41-S-1044-125) (fig. 60).

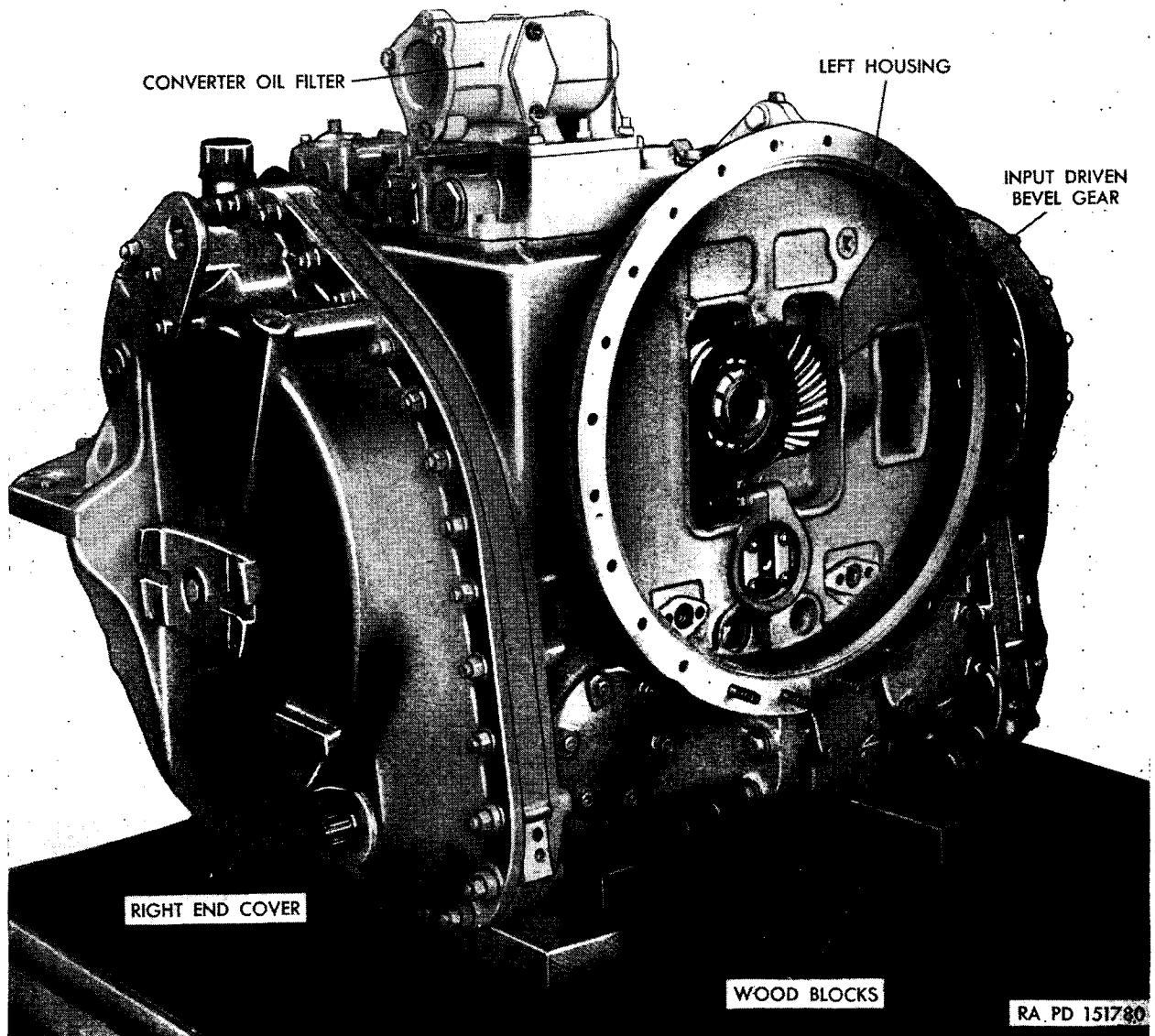


Figure 41. Transmission resting on blocks.

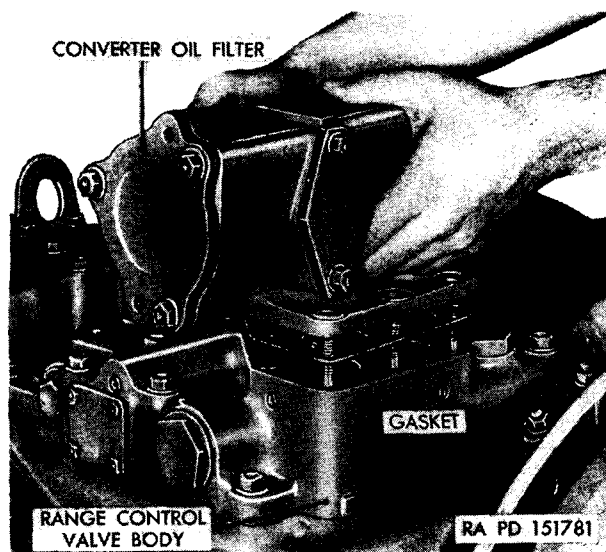


Figure 42. Removing or installing converter-oil-filter assembly.

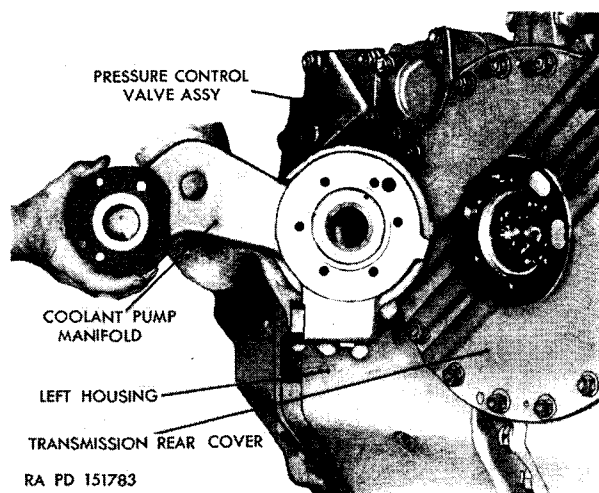


Figure 44. Removing or installing coolant pump manifold.

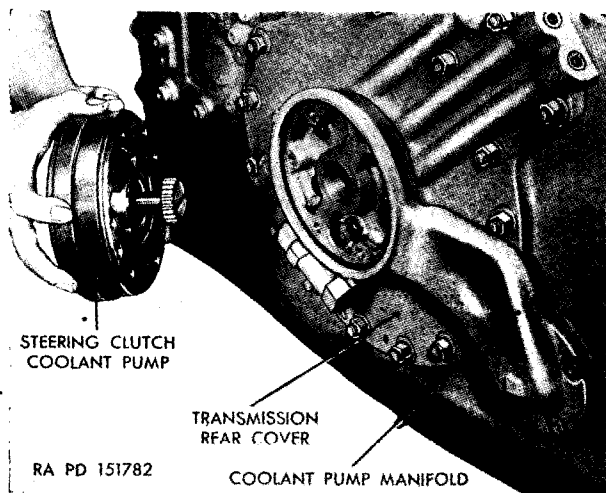


Figure 43. Removing or installing steering-clutch coolant pump.

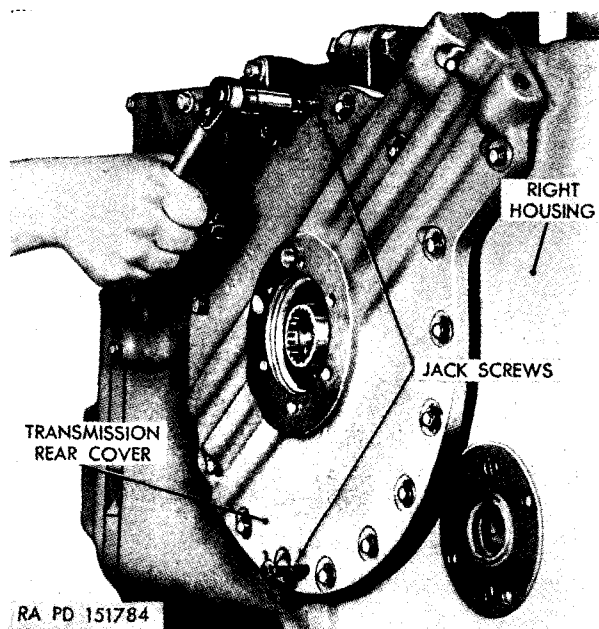


Figure 45. Separating rear cover from housing using jack screws.

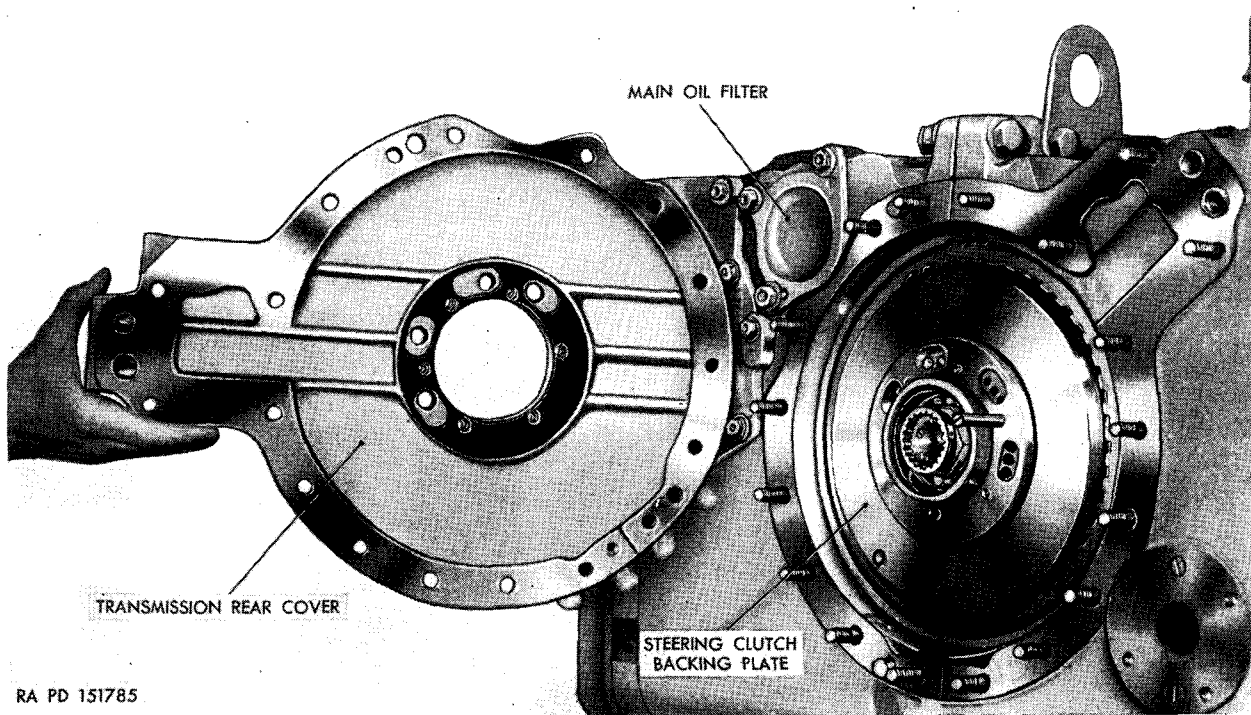


Figure 46. Removing or installing rear cover.

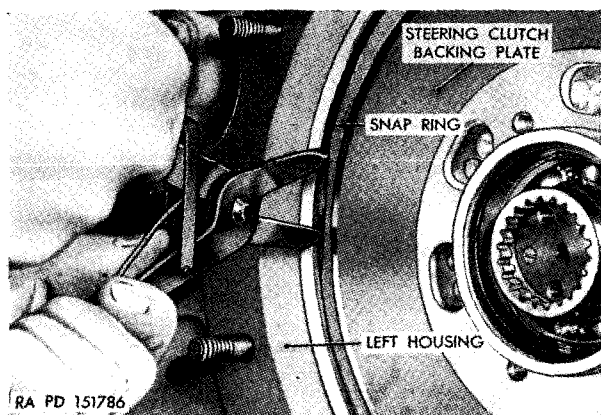


Figure 47. Removing steering-clutch-pack snap ring using pliers (41-P-1992-36).

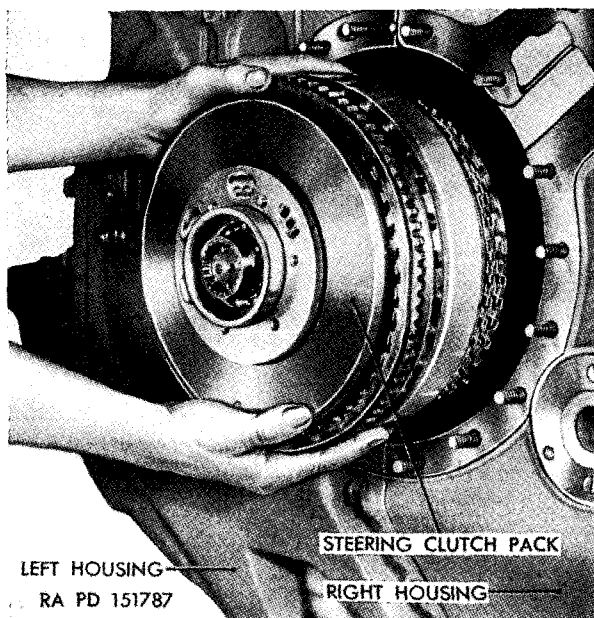


Figure 48. Removing steering-clutch pack.

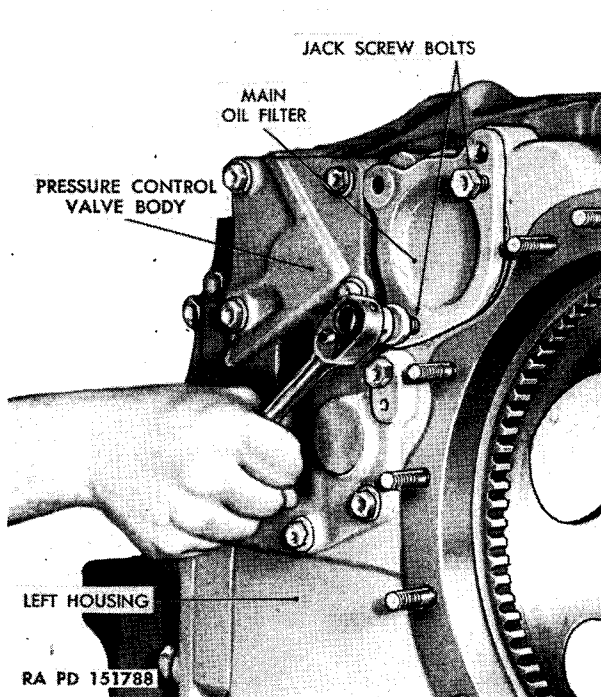


Figure 49. Separating main oil filter from left housing using jack screws.

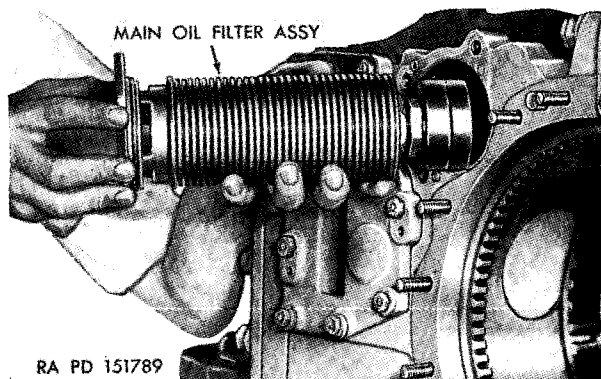


Figure 50. Removing main oil filter assembly.

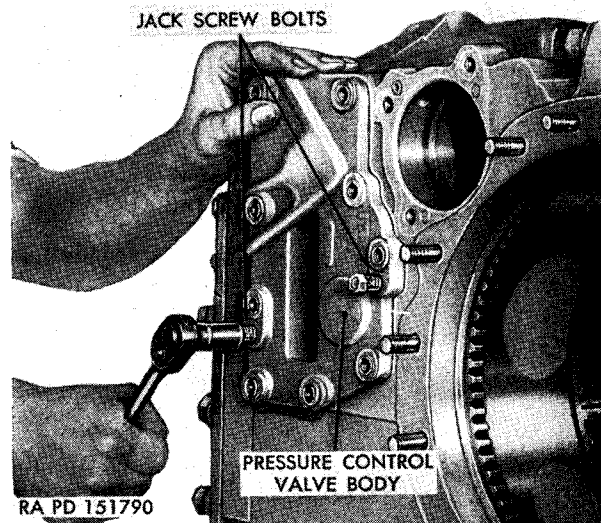


Figure 51. Separating pressure-control valve body from left housing using jack screws.

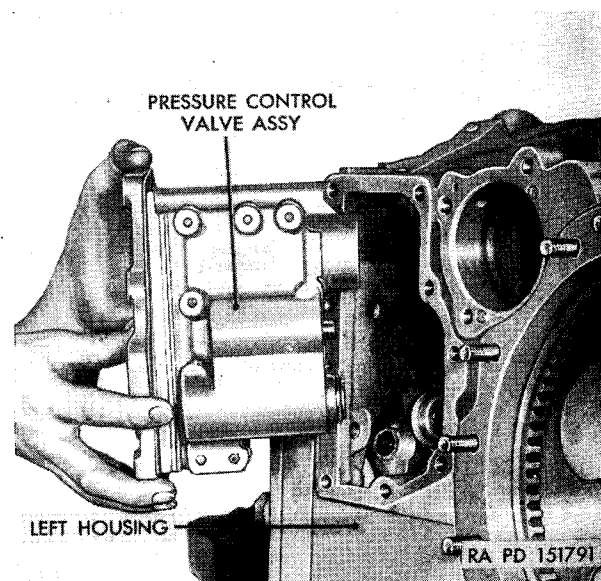


Figure 52. Removing pressure-control valve assembly.

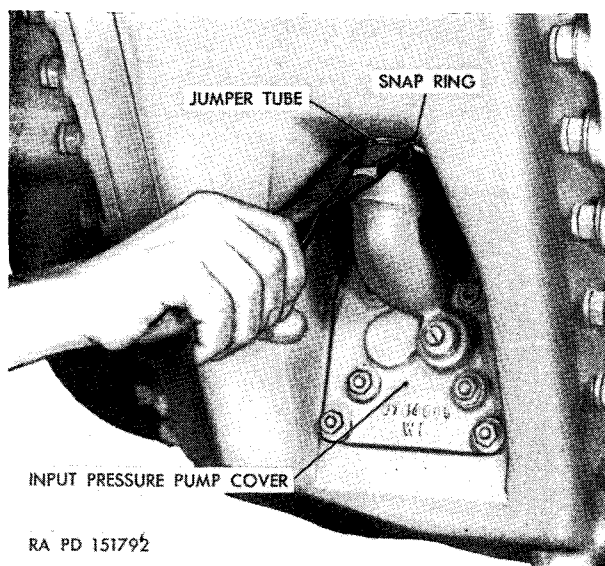


Figure 53. Removing input-pressure-pump snap ring.

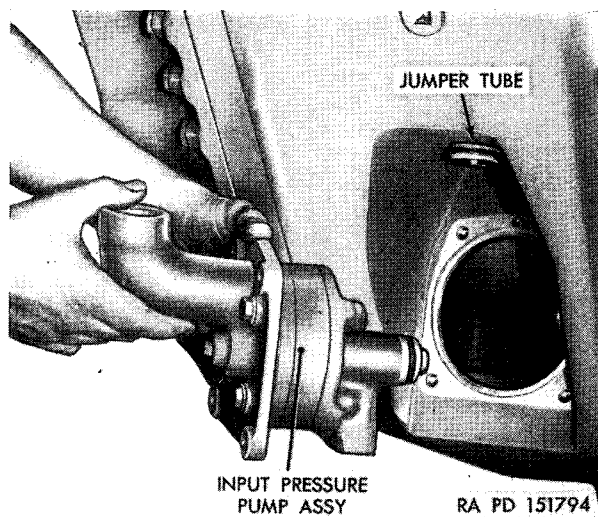


Figure 55. Removing input-pressure pump.

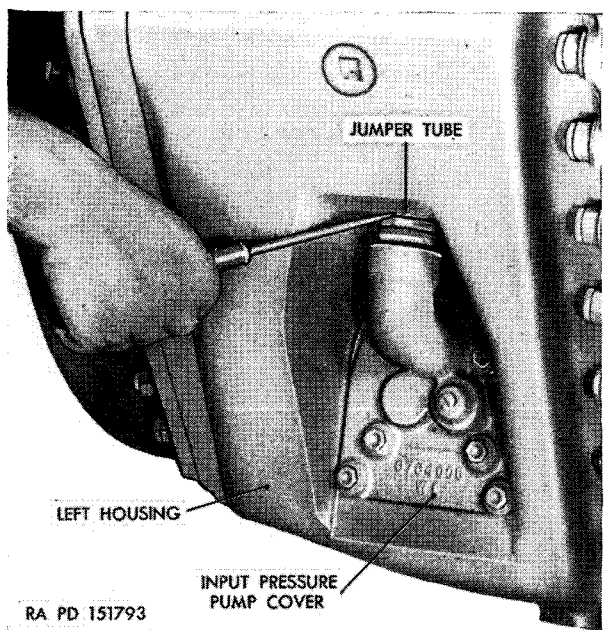


Figure 54. Separating jumper tube from input-pressure pump.

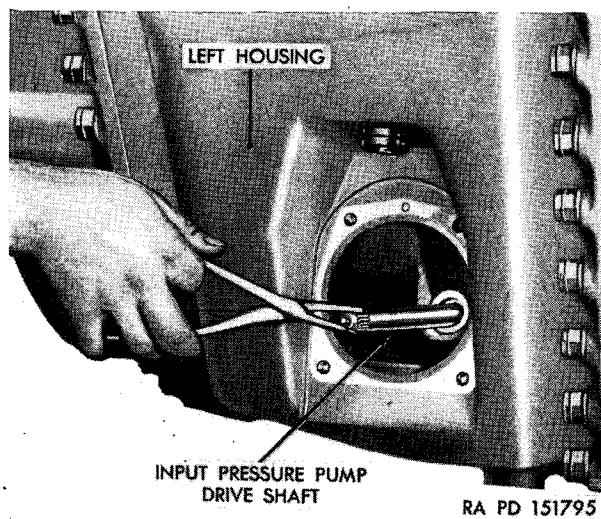


Figure 56. Removing input-pressure pump drive shaft.

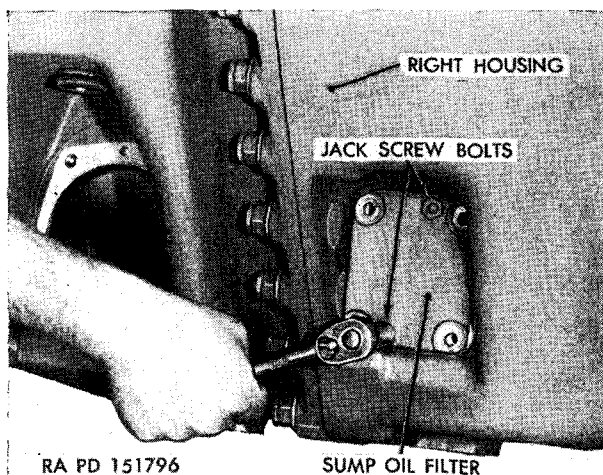


Figure 57. Separating sump oil filter from right housing using jack screws.

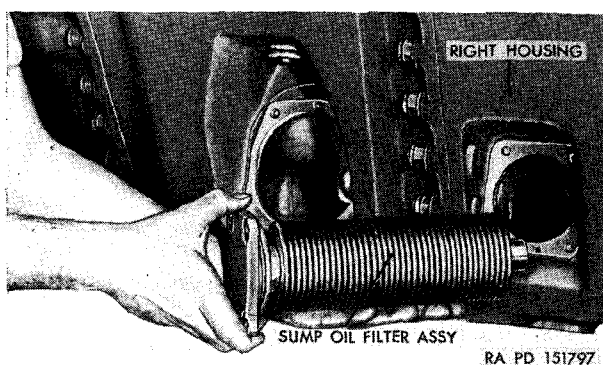


Figure 58. Removing sump oil filter.

Remove the left end cover from the left end plate (fig. 61).

Note. In removing the end cover be careful to prevent the left output ring gear from sliding off the cross-drive shaft.

Lift the left output ring gear off the cross-drive shaft (fig. 62).

- (5) Remove the shim pack from the cross-drive shaft (fig. 63).

f. REMOVAL OF LEFT END PLATE ASSEMBLY.

Attach the lifting sling (41-S-3830-550) to the left end plate. Attach the hoist to the lifting sling. Separate the left end plate from the left housing with the aid of three puller screws (41-S-1044-125) (fig. 64). Remove the left end plate from the left housing (fig. 65).

Note. Between the output-brake and pressure-pump and the pump-regulator body there are three jumper tubes. To prevent loss or damage to the tubes, keep them with the pump.

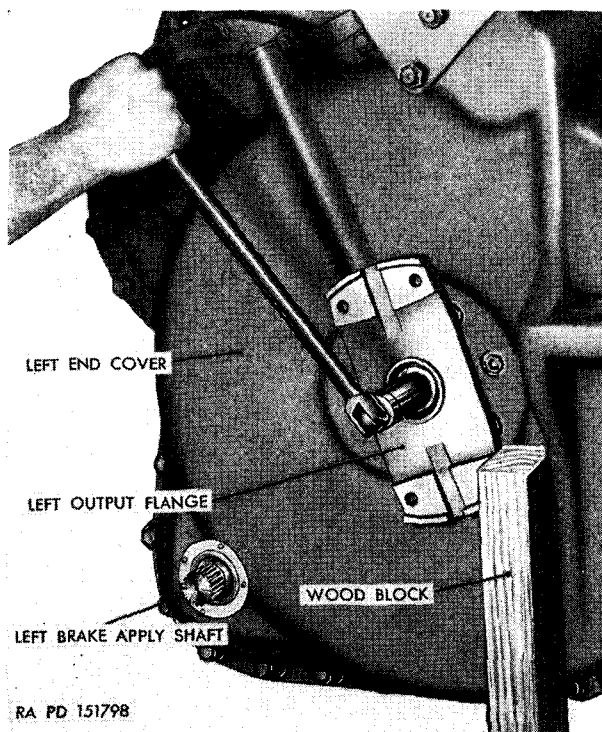


Figure 59. Loosening flange retainer nut.

g. REMOVAL AND DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY.

- (1) Using a $\frac{3}{32}$ -inch wrench, remove the lock screw from the face of the converter-drive-gear spanner nut (fig. 66). Remove one converter-drive-bearing-cage bolt and install in its place the holding plug (A7083776) in one of the cannon holes in the gear.

Note. Later models of the CD-500 transmission do not have the cannon holes in the converter drive gear. Information on the removal of this gear and on special tools needed for the operation will be furnished when available.

- (2) Install the wrench (B7083775) (fig. 67) and remove the converter drive-gear spanner nut with torque wrench (41-W-3634) (fig. 68). Remove the holding plug.
- (3) Lift the converter drive gear off the input-driven-bevel gear shaft (fig. 69).
- (4) With a $\frac{1}{2}$ -inch wrench, remove 24 bolts from the converter lock-up clutch housing. Lift off the converter lock-up clutch assembly (fig. 70).

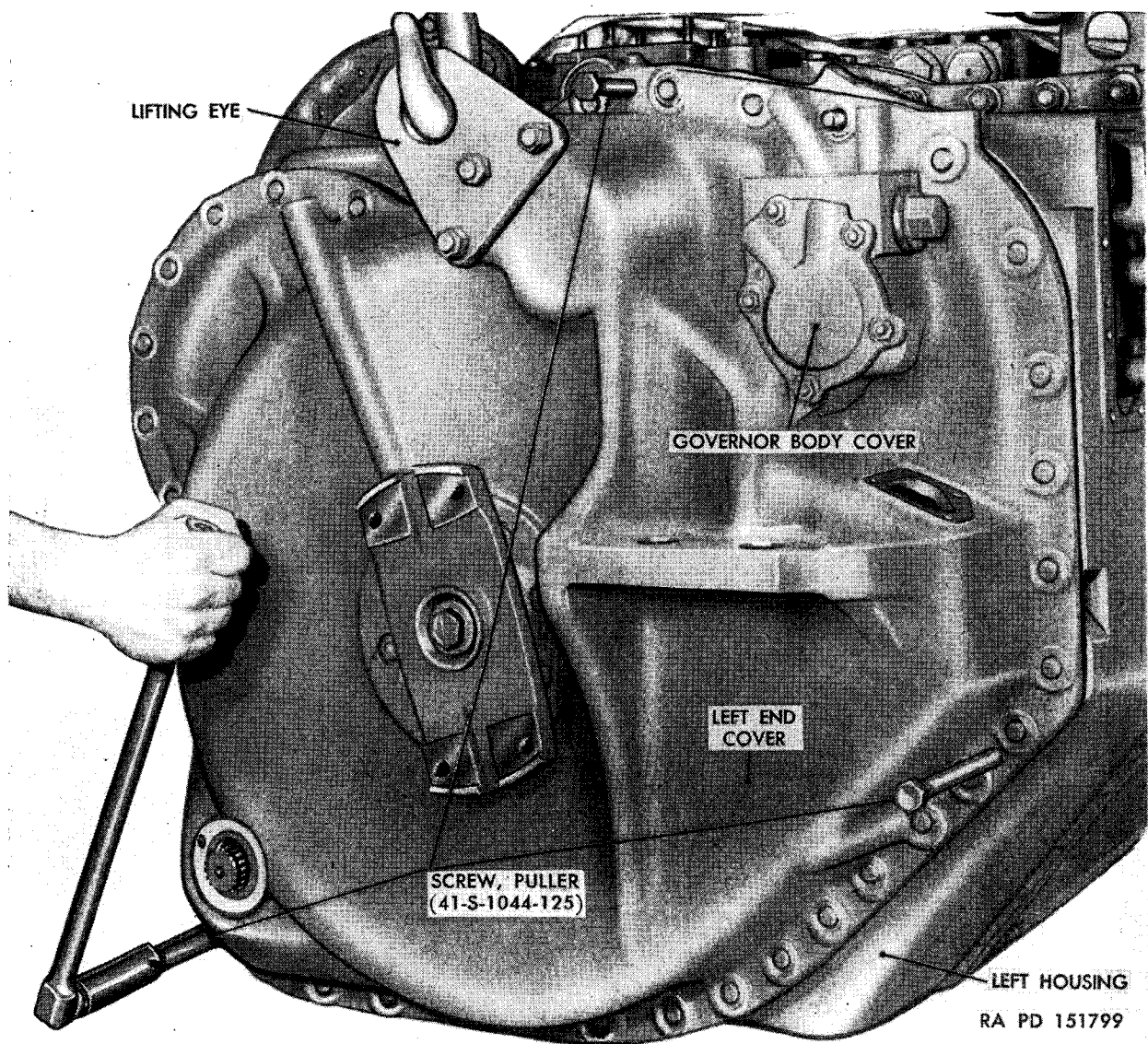


Figure 60. Separating left end cover from end plate.

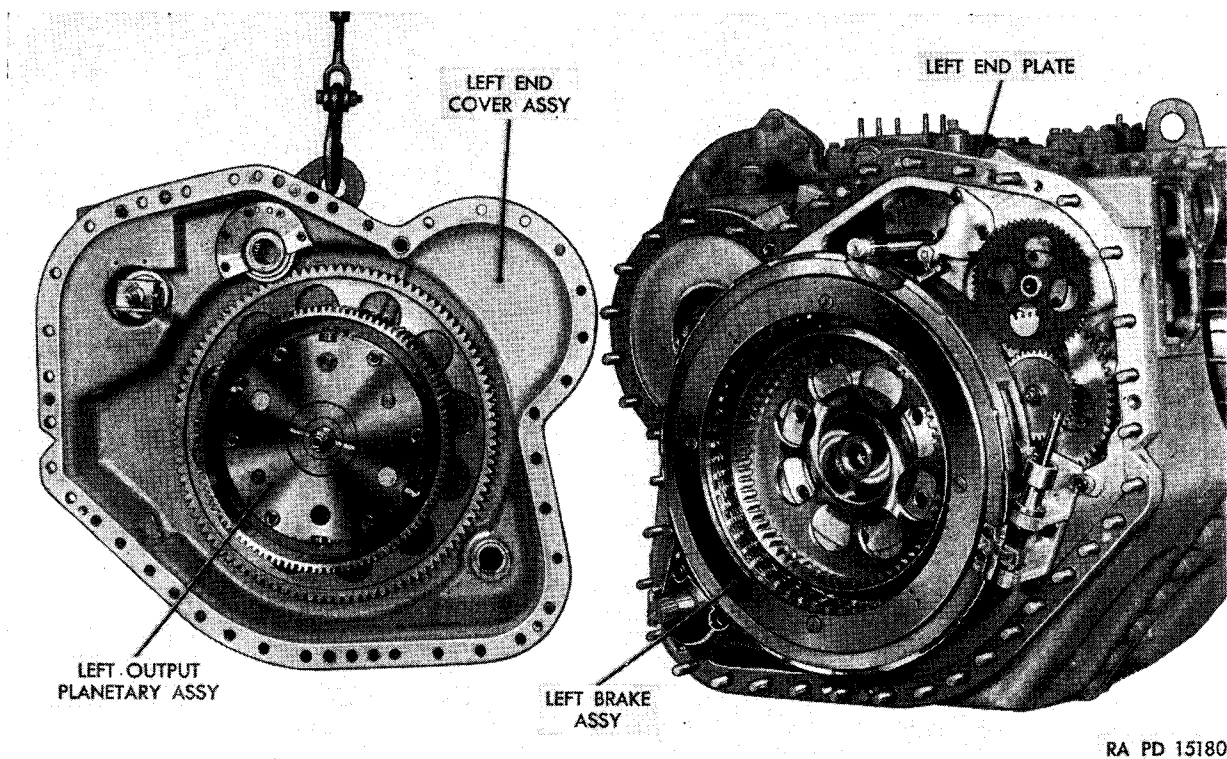


Figure 61. Removing left end cover.

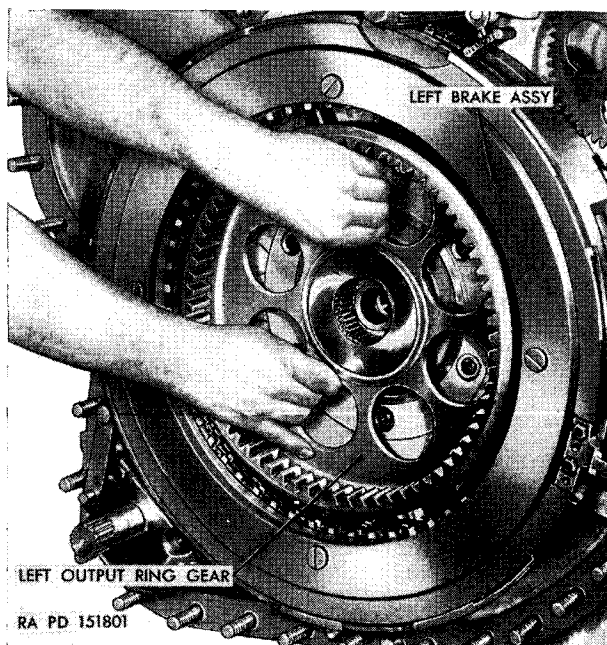


Figure 62. Removing or installing left-output ring gear.

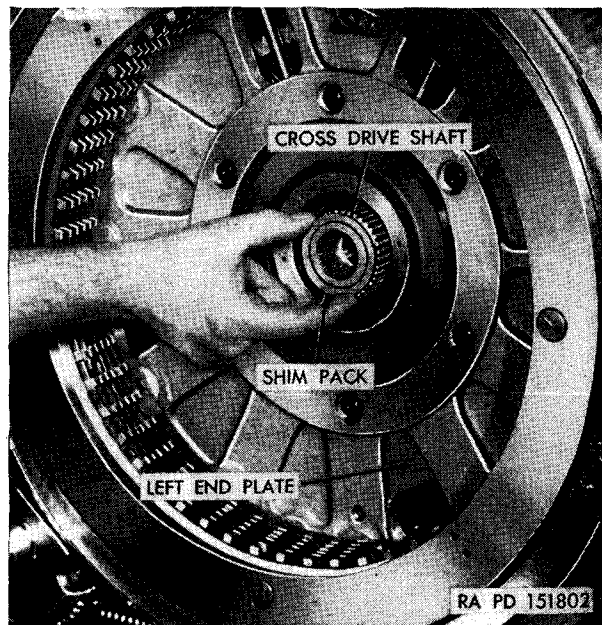


Figure 63. Removing or installing shim pack.

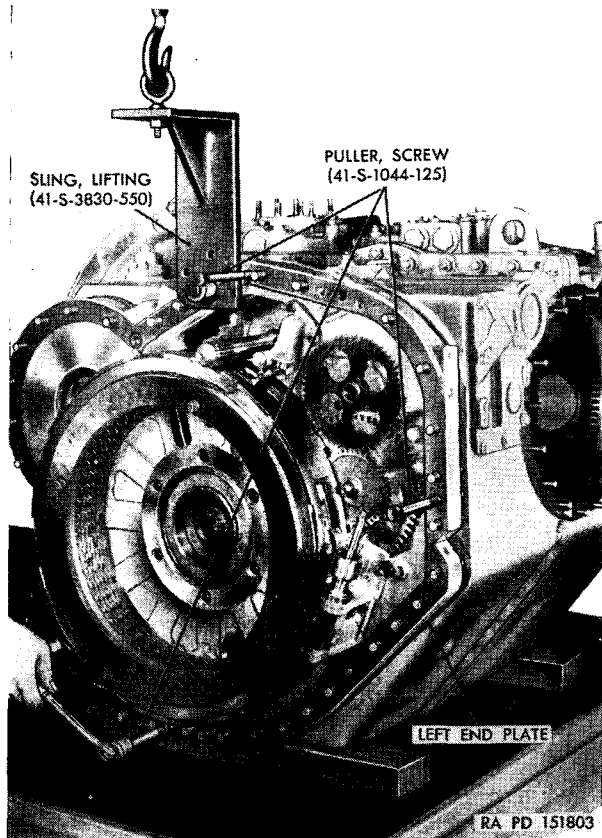


Figure 64. Separating left end plate from left housing using puller screws.

- (5) Remove the converter turbine-and-shaft assembly (fig. 71). Using pliers (C7083704), remove the retainer snap ring from the converter ground sleeve (fig. 72).

- (6) Remove the stator retainer (fig. 73).

Note. The stator retainer is locked to the converter ground sleeve with a $\frac{3}{16}$ -inch steel ball to prevent its rotation. In removing the retainer, be careful not to lose this locking ball.

- (7) Insert the arbor (41-A-339-24) into the converter ground sleeve (fig. 74). Holding the stator pack and the converter pump together, and keeping the arbor in place, pull out the stator pack until it is well onto the arbor (fig. 75). Push the converter pump back into place and remove the stator pack and arbor as a unit (fig. 76).
- (8) Lift out the converter pump assembly (fig. 77). Remove the converter seal assembly from the ground sleeve (fig. 78).

- (9) Remove 10 bolts and washers, using a $\frac{5}{16}$ -inch socket, and remove one bolt, 11 nuts, and 12 washers, using a $\frac{5}{16}$ -inch socket, from the converter and oil reservoir wells in the left housing. Remove two bolts, using a $\frac{3}{4}$ -inch socket, from the converter ground sleeve.

Caution: To prevent possible damage as well as unnecessary handling of the transmission during the separation of the right housing from the left housing, all bolts and nuts must be removed from the converter and reservoir wells at this time.

h. REMOVAL OF RIGHT END COVER ASSEMBLY.

Using a $\frac{1}{2}$ -inch wrench, remove three capscrews and washers from the brake adjustment cover and remove it from the end cover (fig. 79). Attach the hoist to the lifting eye on the end cover. Using a $\frac{3}{4}$ -inch wrench, remove 36 jam nuts, nuts, and washers securing the cover to the plate. Brake the safety wire on the retainer nut of the output flange. Place a wooden block between the flange and the end cover. Using a $\frac{5}{8}$ -inch socket, loosen the nut but do not remove it. With the aid of three puller screws (41-S-1044-125) (fig. 80), separate the end cover from the end plate. Remove the right end cover assembly, holding it as level as possible (fig. 81).

i. REMOVAL OF RIGHT END PLATE ASSEMBLY.

- (1) Remove two bolts from the brake-adjustment bracket, using a $\frac{5}{16}$ -inch wrench. Remove two bolts from the brake-adjusting-yoke bracket, using a $\frac{1}{2}$ -inch wrench.
- (2) Remove (at the same time) the brake-adjustment bracket and the brake-adjusting-yoke bracket by tapping off two dowel pins (fig. 82).
- (3) Install the brake-apply ring and brake-apply-cam rotating ring retainer (C7083772) to prevent spilling the 229 ball bearings located between these two parts. See figure 90.
- (4) Break the locking wire on the brake-apply-strut-retainer bolt (fig. 83). Remove the retainer bolt, wave washer, retainer and spacer, using a $\frac{5}{16}$ -inch wrench.
- (5) Using a screwdriver, rotate the brake-apply-cam rotating ring until the brake-apply strut can be removed (fig. 84).

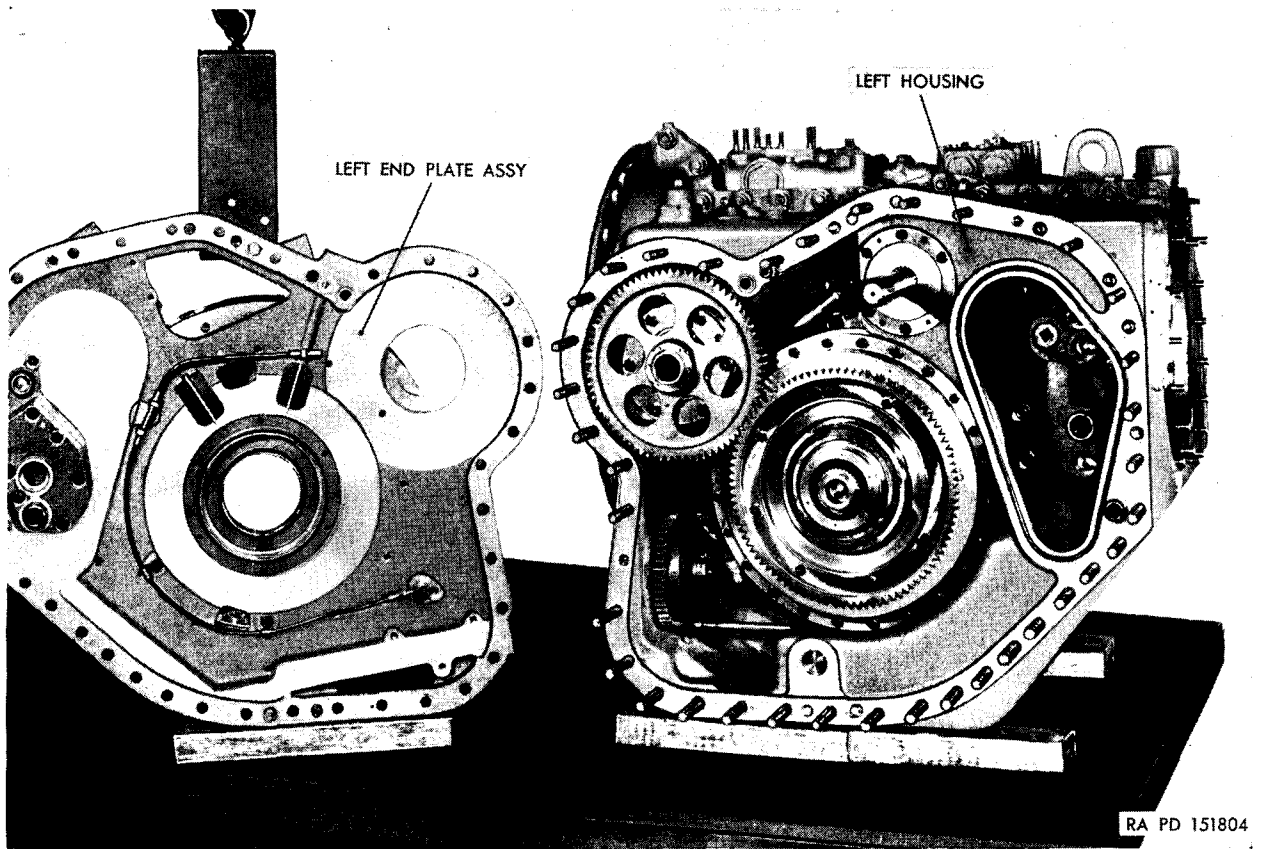


Figure 65. Removing left end plate.

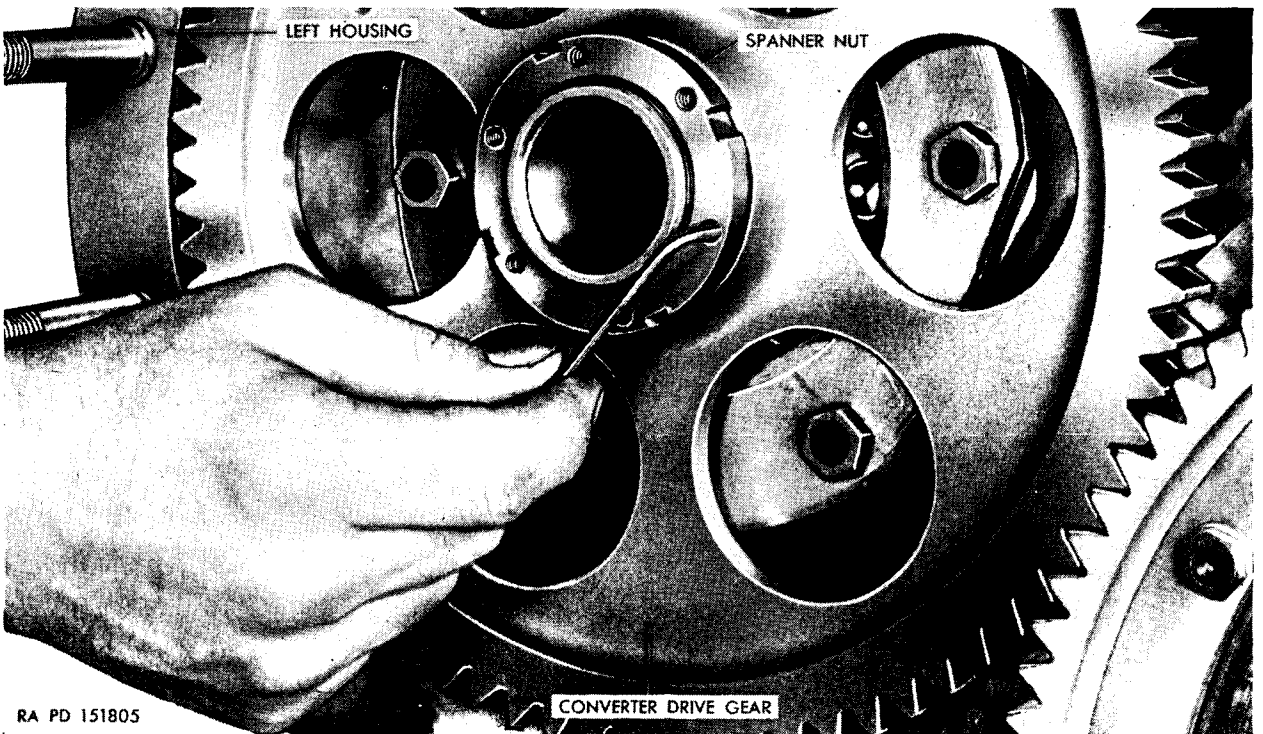


Figure 66. Removing or installing spanner nut lock screw.

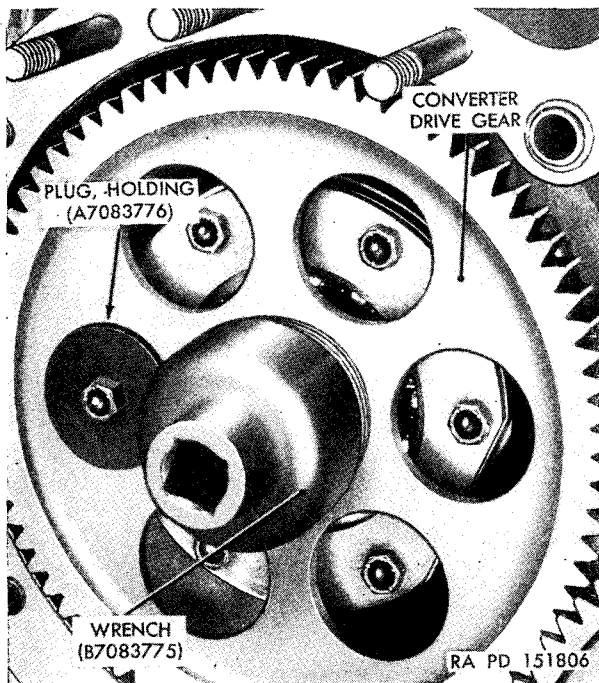


Figure 67. Special tools installed.

Pry out the brake-apply-cam-return spring and guide from its socket, with a screwdriver (fig. 85).

- (6) Using a ½-inch wrench, remove one bolt from the brake-return-cam bracket. Remove the brake-return-cam bracket and the brake-cooling-oil valve from the brake-apply-cam rotating ring (fig. 86).
- (7) Using a ⅝-inch wrench, remove four bolts from the brake-shaft bracket. Lift the brake-shaft bracket assembly off the two dowel pins (fig. 87).
- (8) Using a ½-inch wrench, remove two bolts from the brake-apply-cam bracket. Gently tap the bracket to loosen it and take it off the dowel pin (fig. 88).
- (9) With the retainer still in place, use a soft drift to rotate the brake-apply-cam stationary ring (fig. 89) until the ring can be removed from the brake-anchor (fig. 90).

Caution: When rotating the stationary ring for removal, apply pressure to the ring to prevent its jumping from the tangs.

- (10) Lift out the brake disk pack (fig. 91).
- (11) Remove the 10 brake plate release springs.
- (12) Remove the two flat-head countersunk

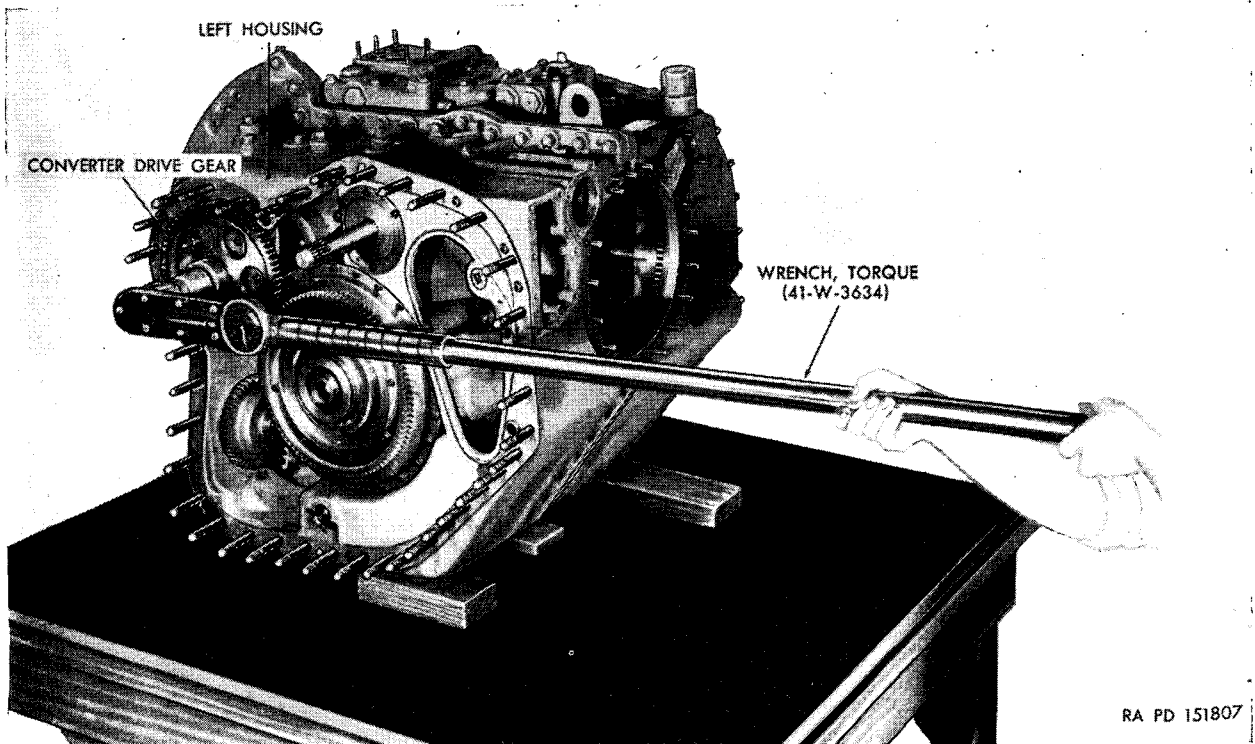


Figure 68. Removing or installing converter-drive-gear spanner nut.

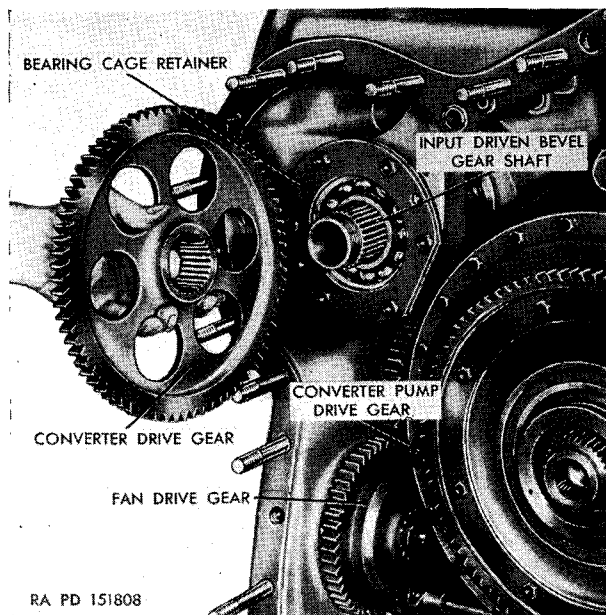


Figure 69. Removing or installing converter drive gear.

screws from the brake-fixed-pressure plate (fig. 92). Lift out the brake-fixed-pressure plate.

- (13) Remove the 10 bolts from the inner-bolt circle and one bolt from the outer-bolt circle of the brake anchor (fig. 93). Lift off the brake anchor (fig. 94).
- (14) Attach the lifting sling (41-S-3830-550) to the end plate. Using three puller screws (41-S-1044-125), separate the end plate assembly from the main housing (fig. 95). Remove the end plate assembly (fig. 96).

j. REMOVAL OF VALVE BODIES.

- (1) Attach the lifting sling (C7083778) to the right housing and raise the assembly with a hoist (fig. 97). Lower the assembly so the left end rests on wooden blocks which have been built high enough to clear the steering clutch shaft (fig. 98).

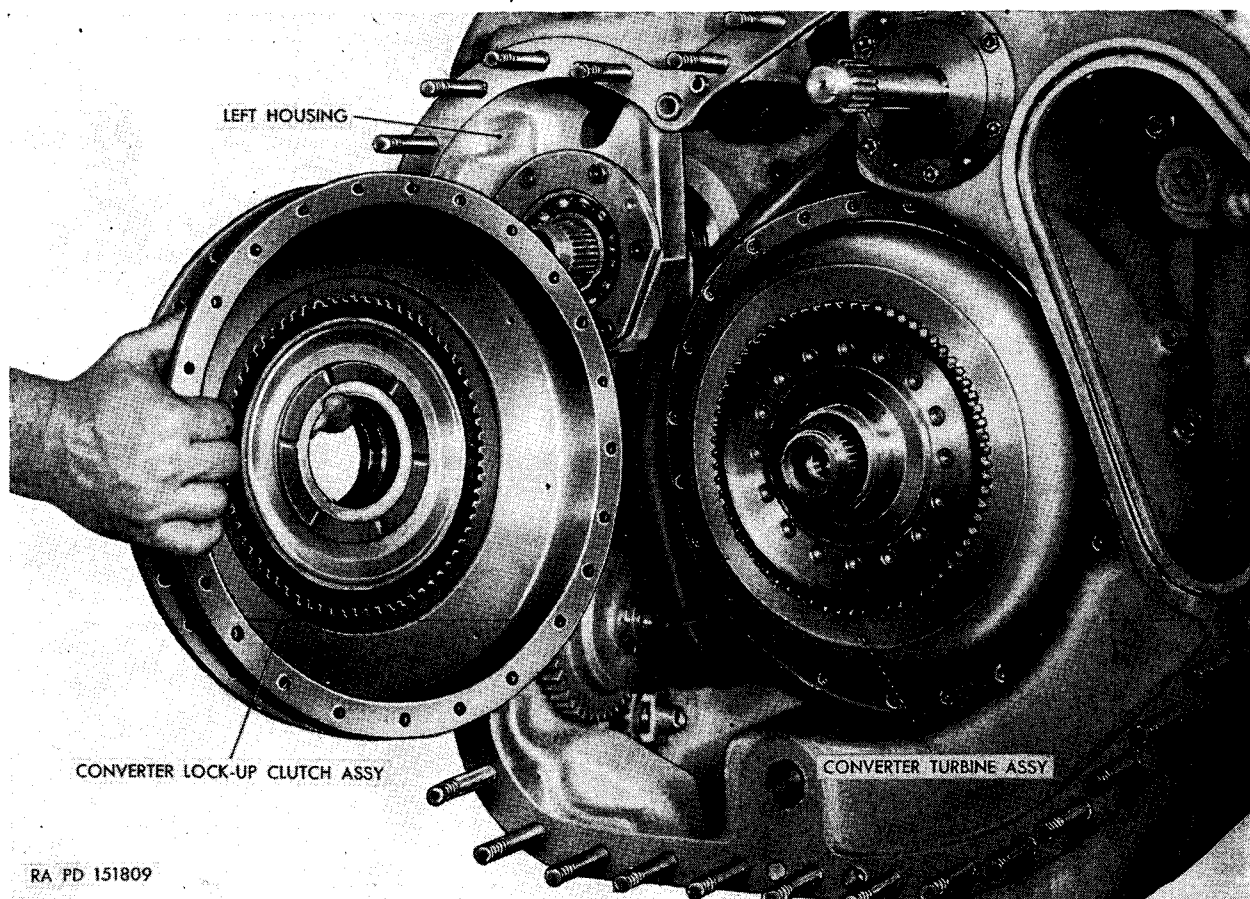


Figure 70. Removing lock-up clutch housing.

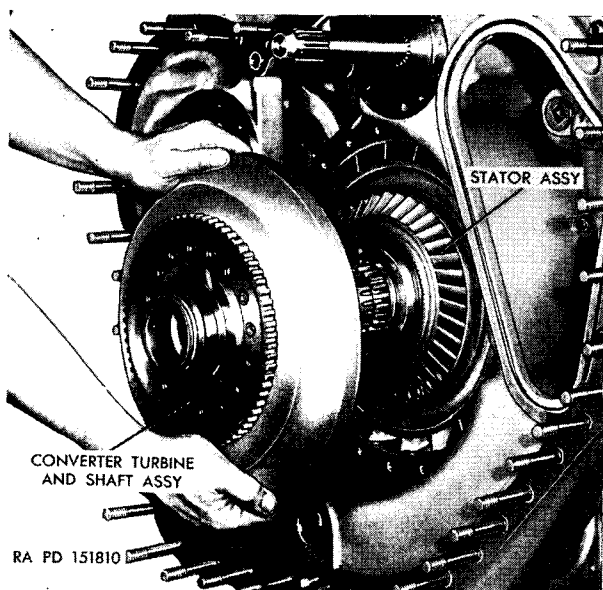


Figure 71. Removing converter turbine and shaft assembly.

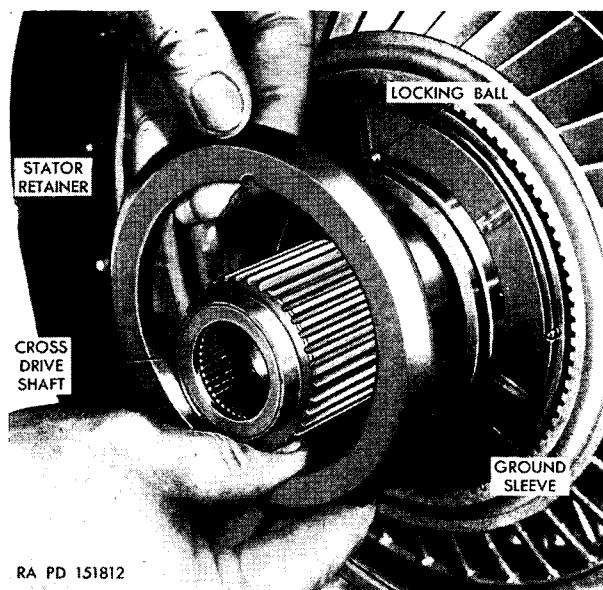


Figure 73. Removing or installing stator retainer.

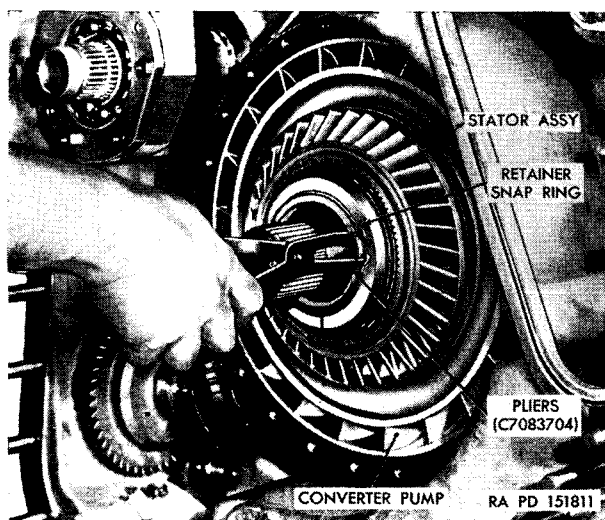


Figure 72. Removing or installing stator-retaining snap ring.

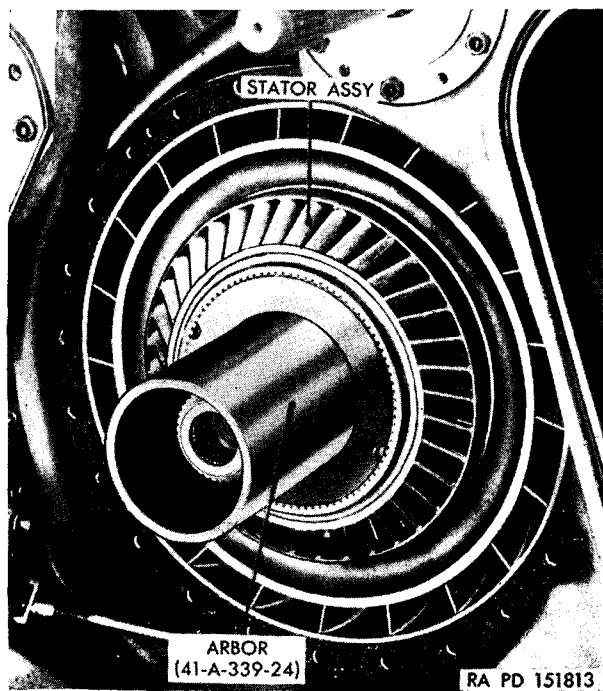


Figure 74. Arbor installed.

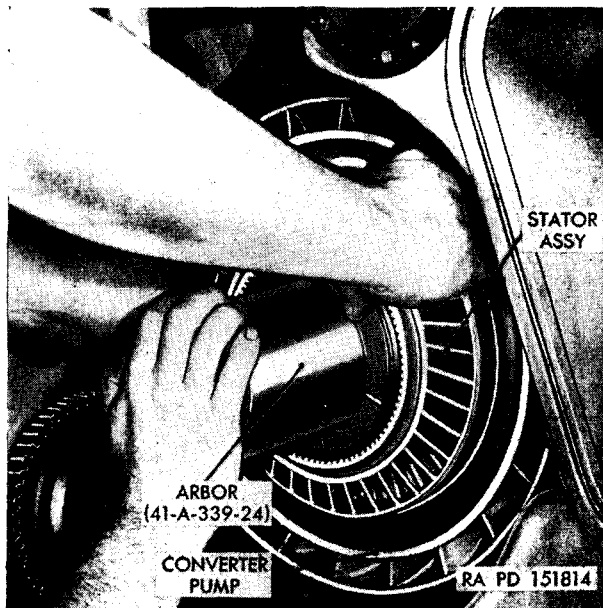


Figure 75. Pulling stators onto arbor.

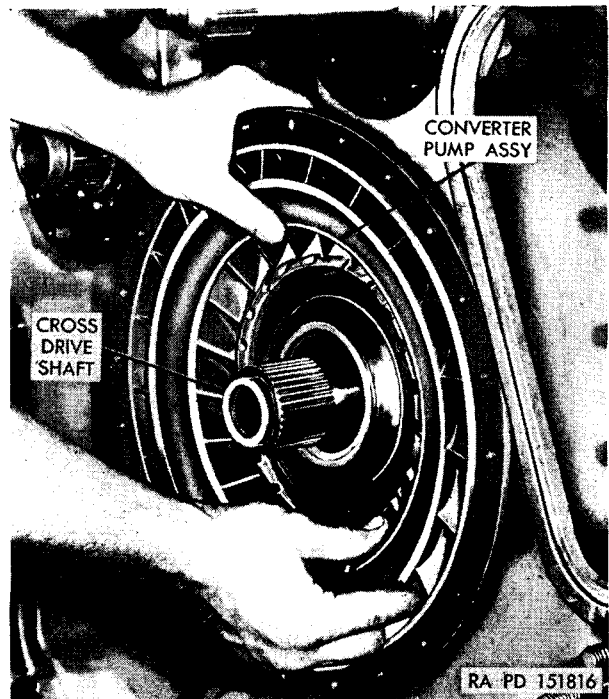


Figure 77. Removing converter pump assembly.

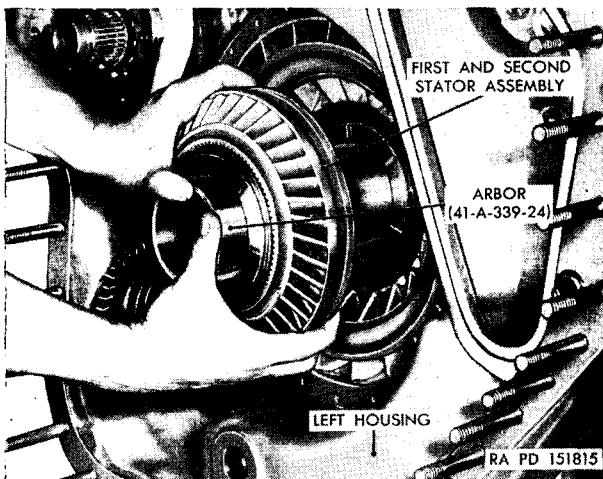


Figure 76. Removing or installing statorpack.

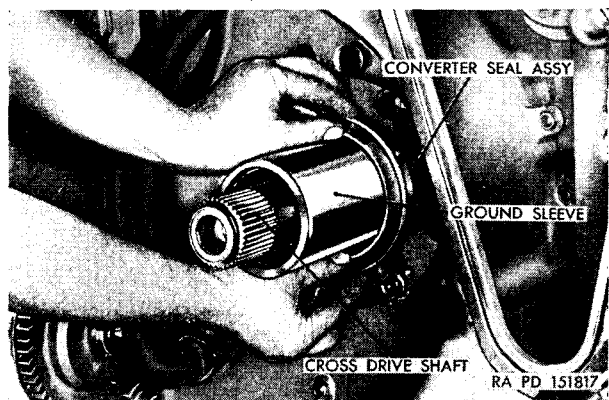


Figure 78. Removing or installing converter seal assembly.

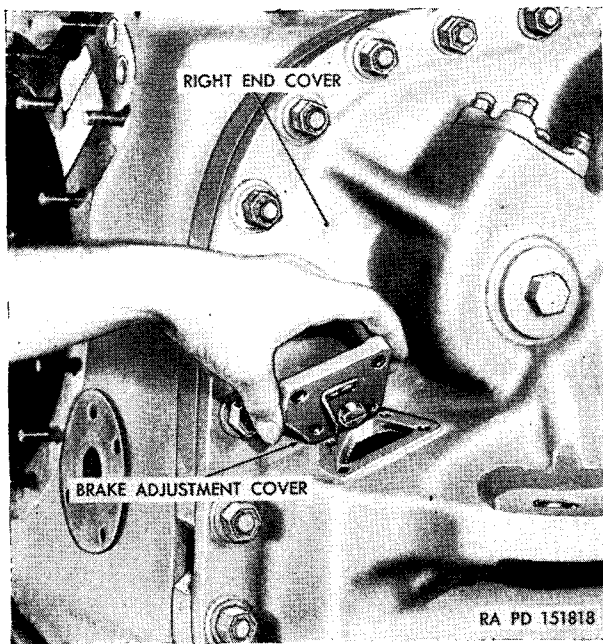


Figure 79. Removing or installing right-brake-adjustment cover.

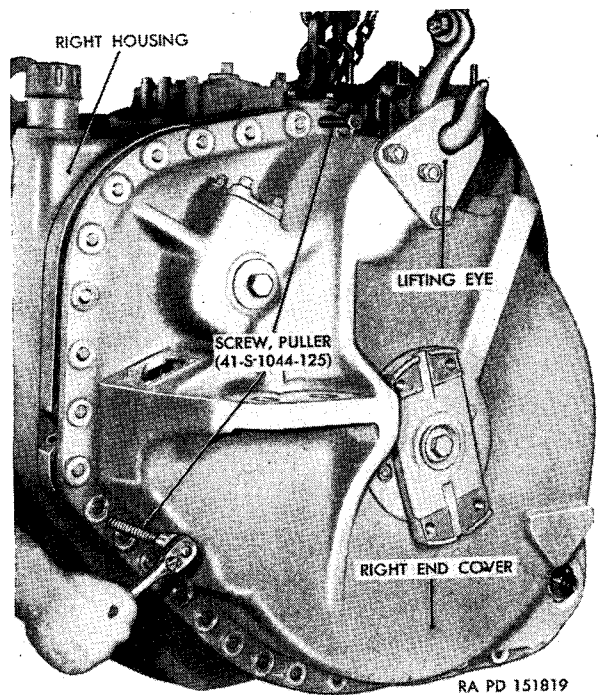


Figure 80. Separating right end cover from end plate.

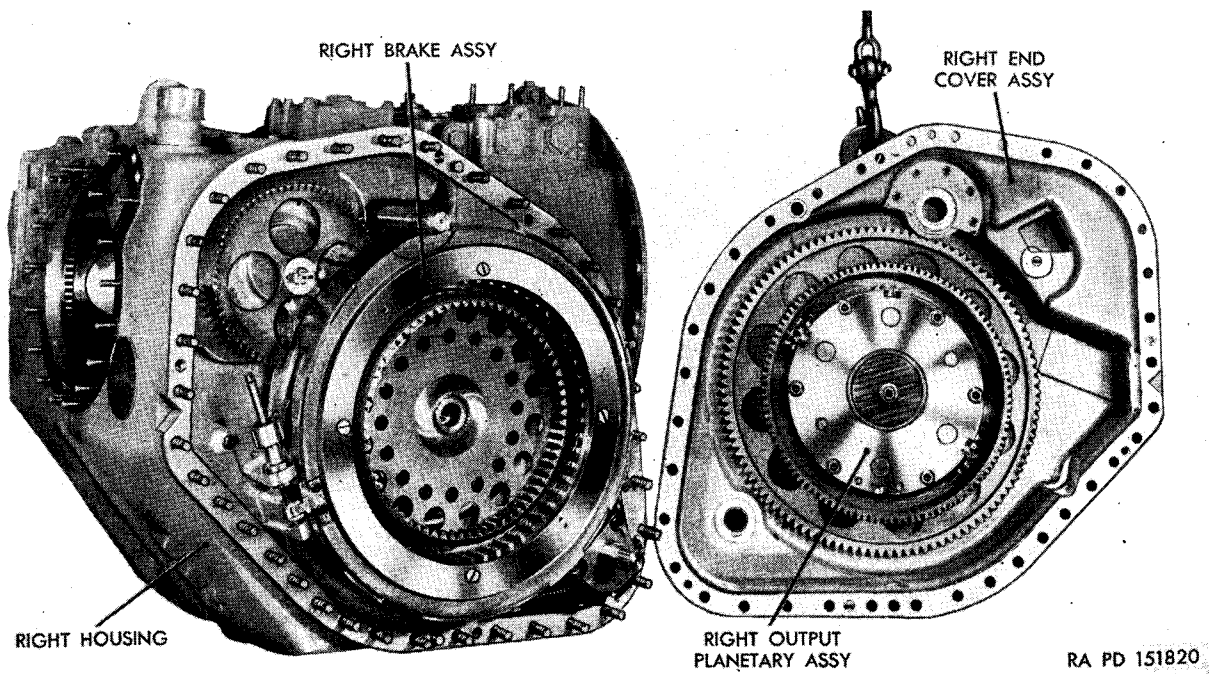


Figure 81. Removing right end cover.

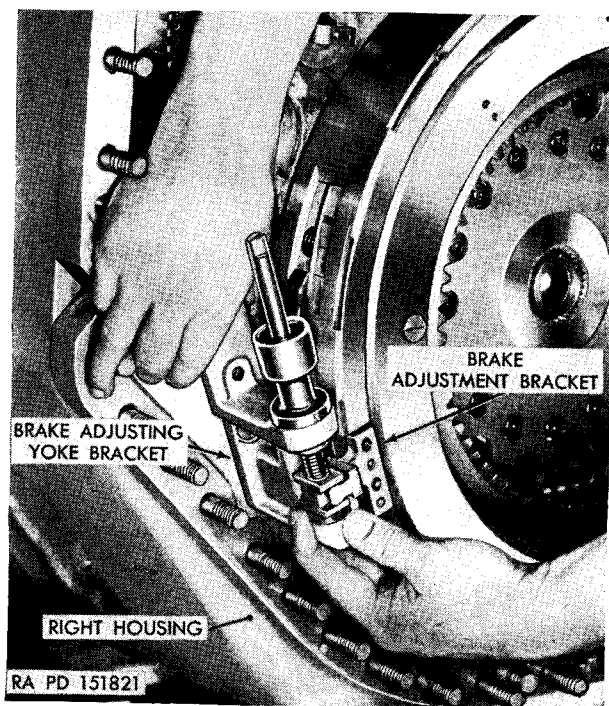


Figure 82. Removing or installing brake-adjustment bracket and yoke.

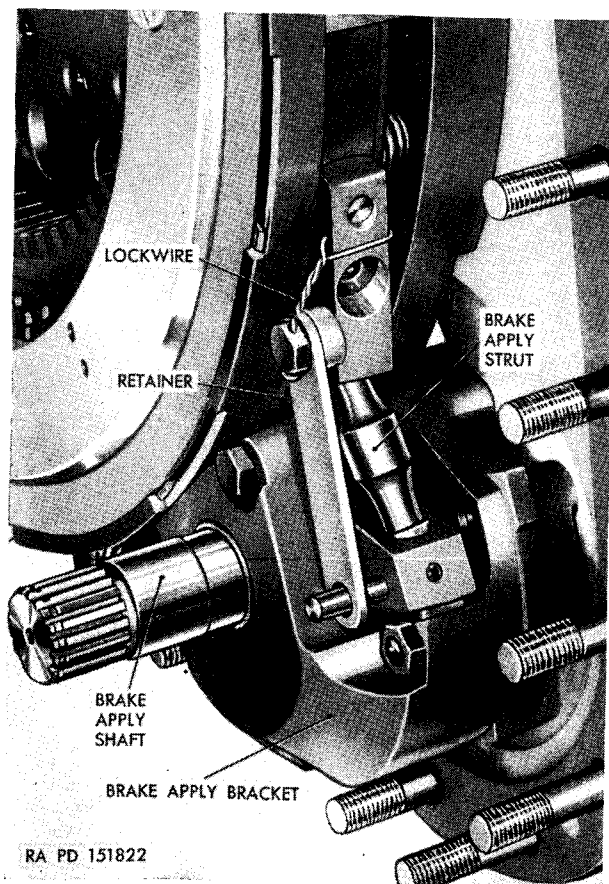


Figure 83. Brake apply mechanism assembly.

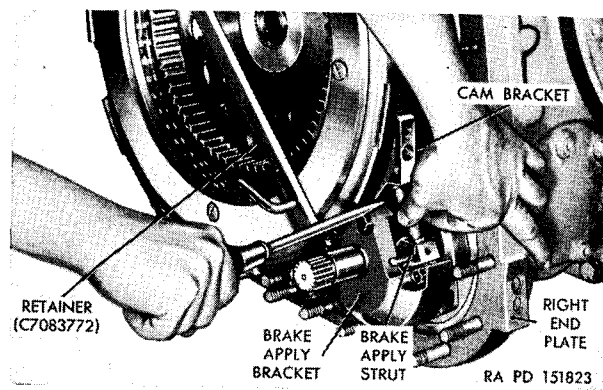


Figure 84. Removing or installing brake apply strut.

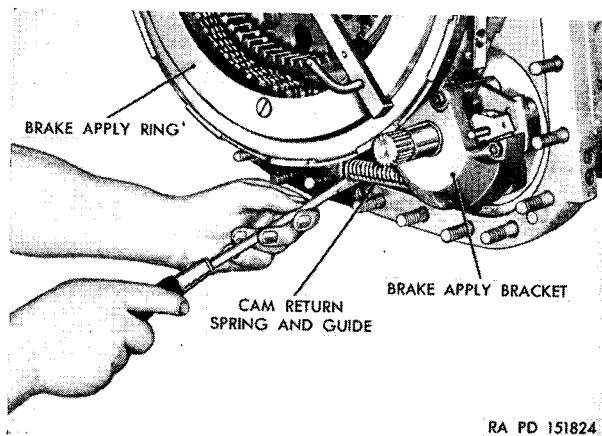


Figure 85. Removing or installing cam-return-spring and guide assembly.

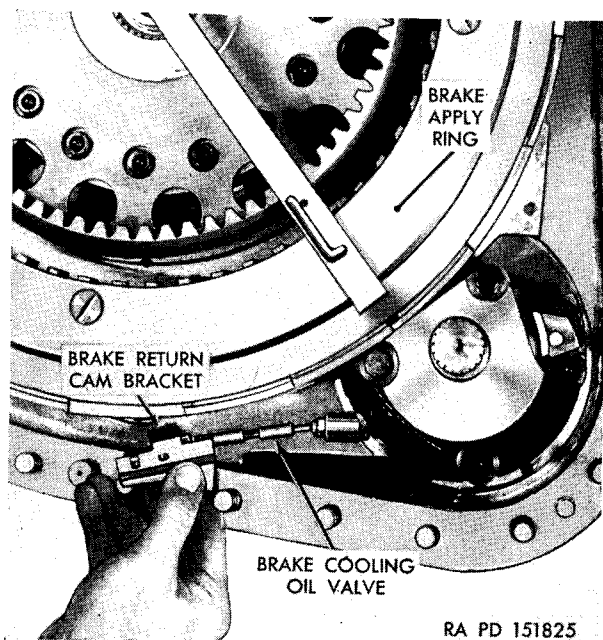


Figure 86. Removing or installing cam bracket and brake lube valve.

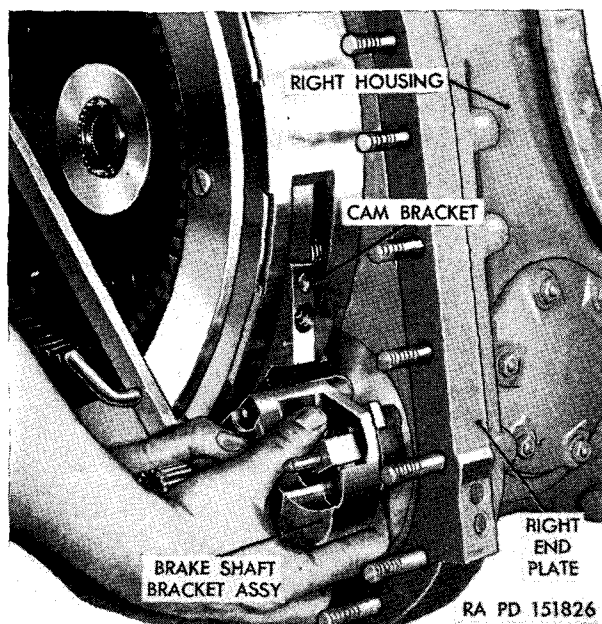


Figure 87. Removing brake-shaft bracket assembly.

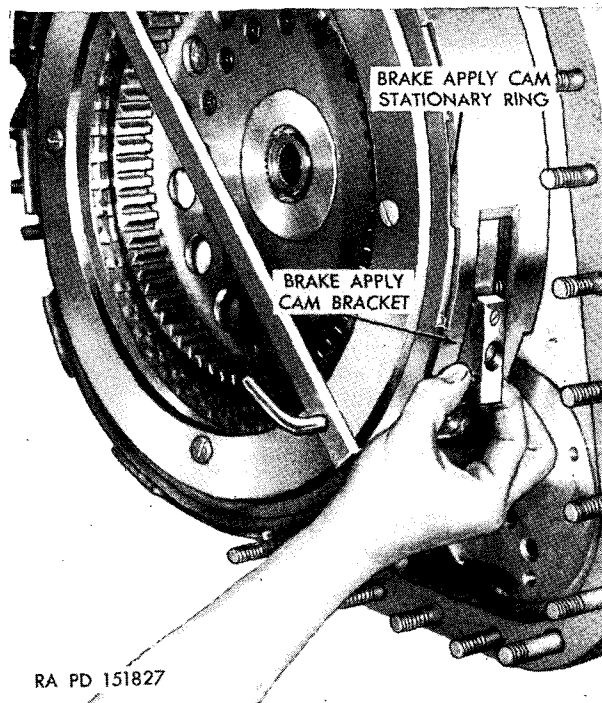


Figure 88. Removing or installing brake-apply-cam bracket.

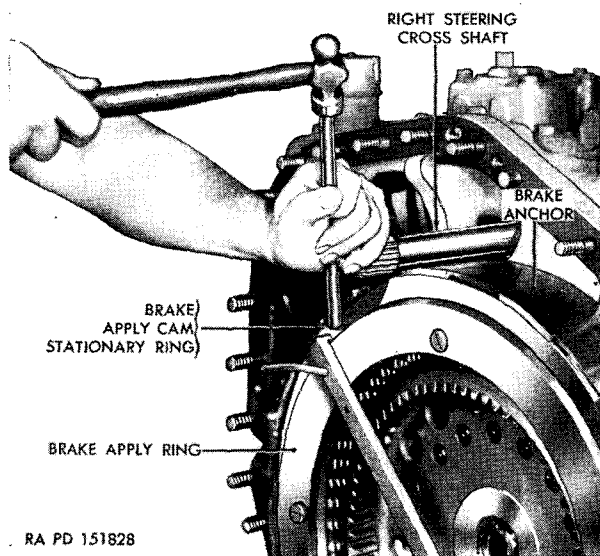


Figure 89. Rotating brake-apply-cam stationary ring.

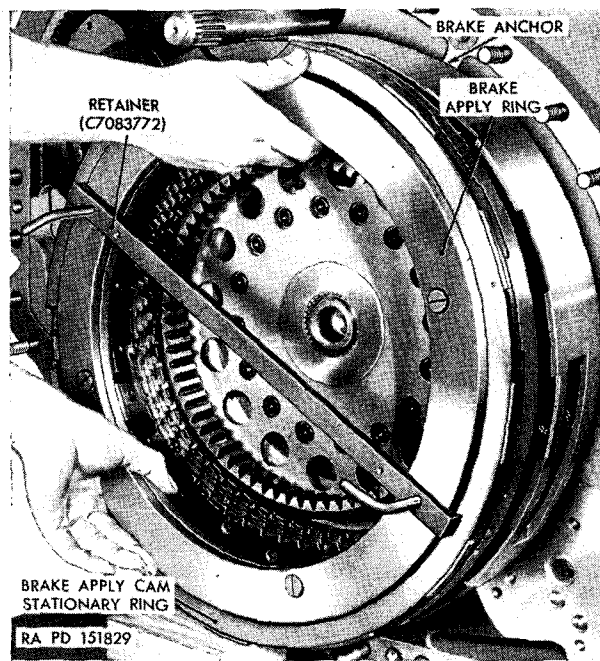


Figure 90. Removing or installing brake-apply ring assembly.

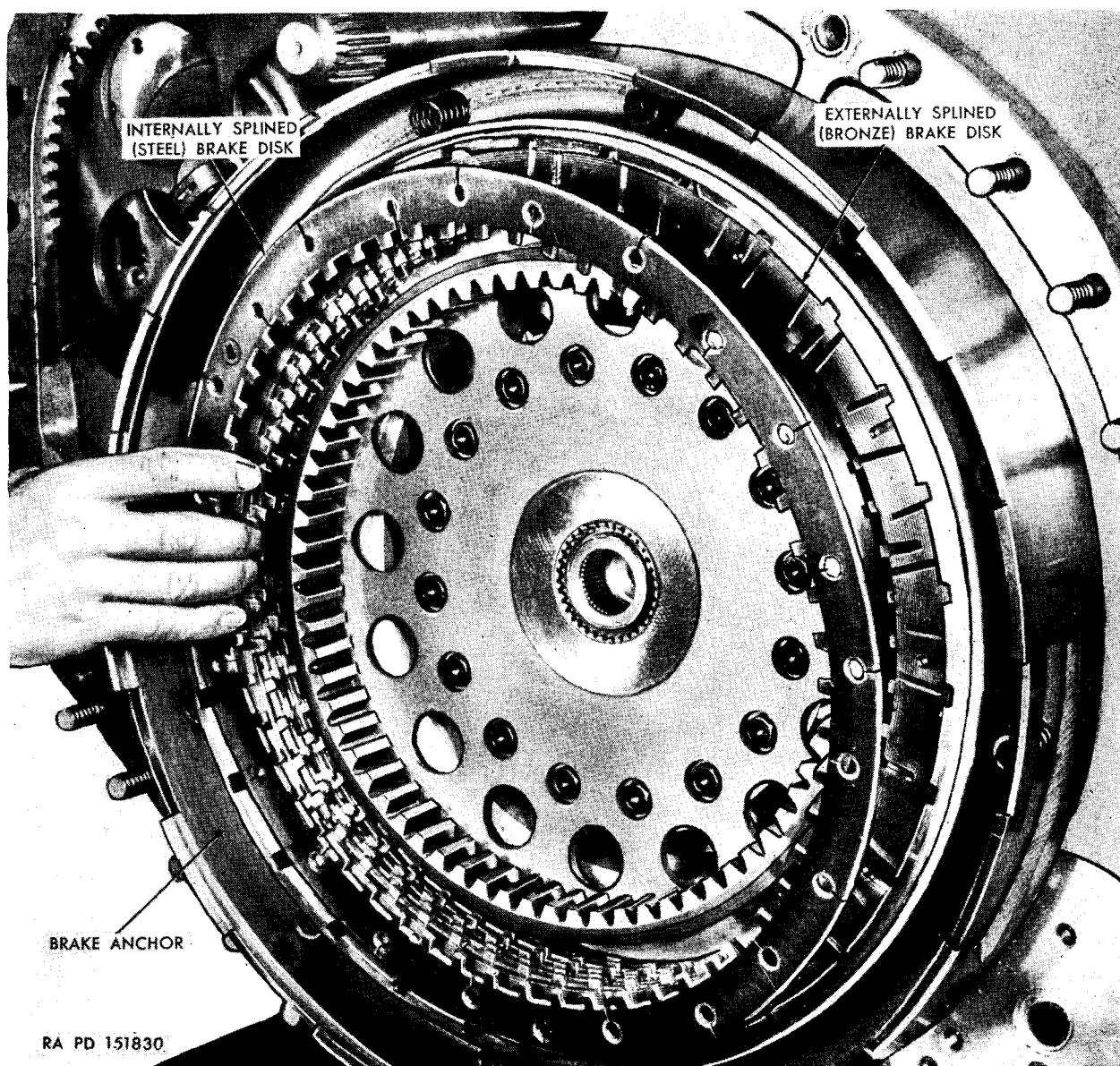


Figure 91. Removing or installing brake disk pack.

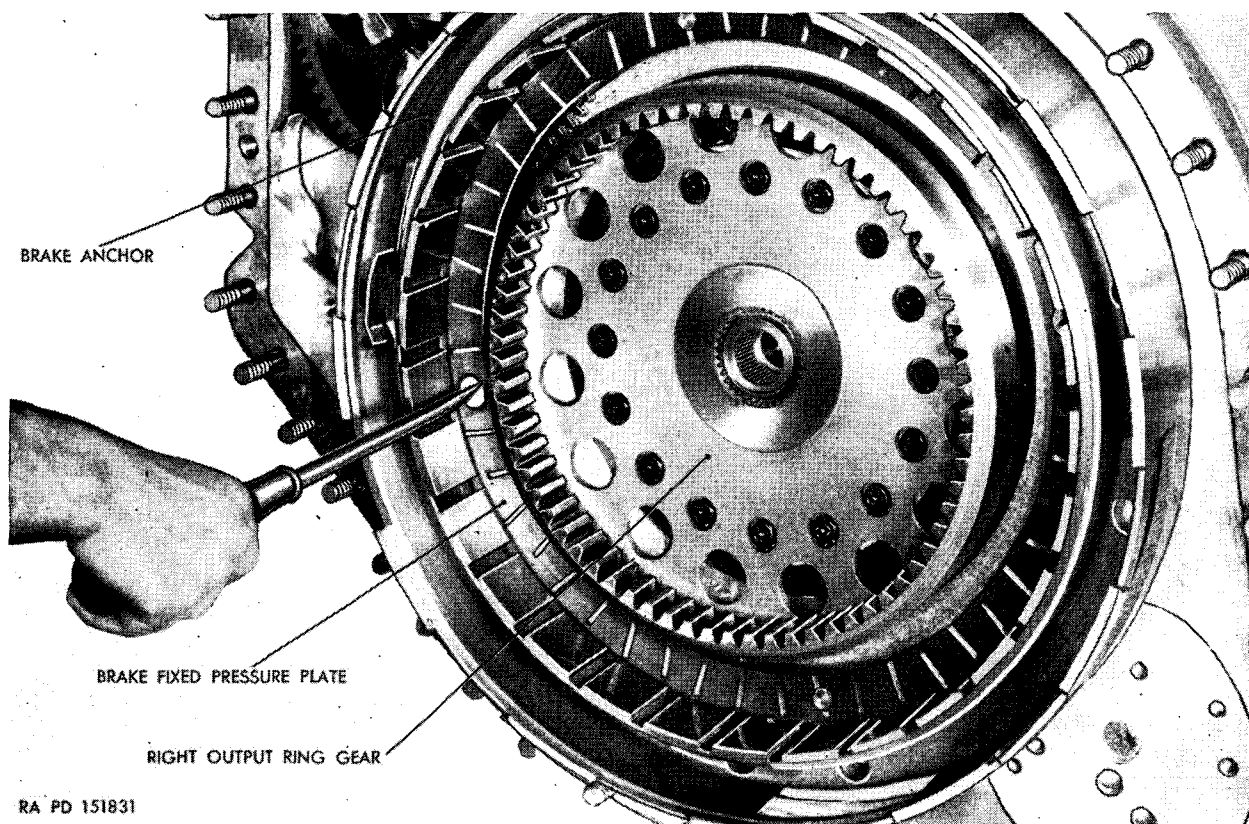


Figure 92. Removing or installing brake-fixed-pressure-plate screws.

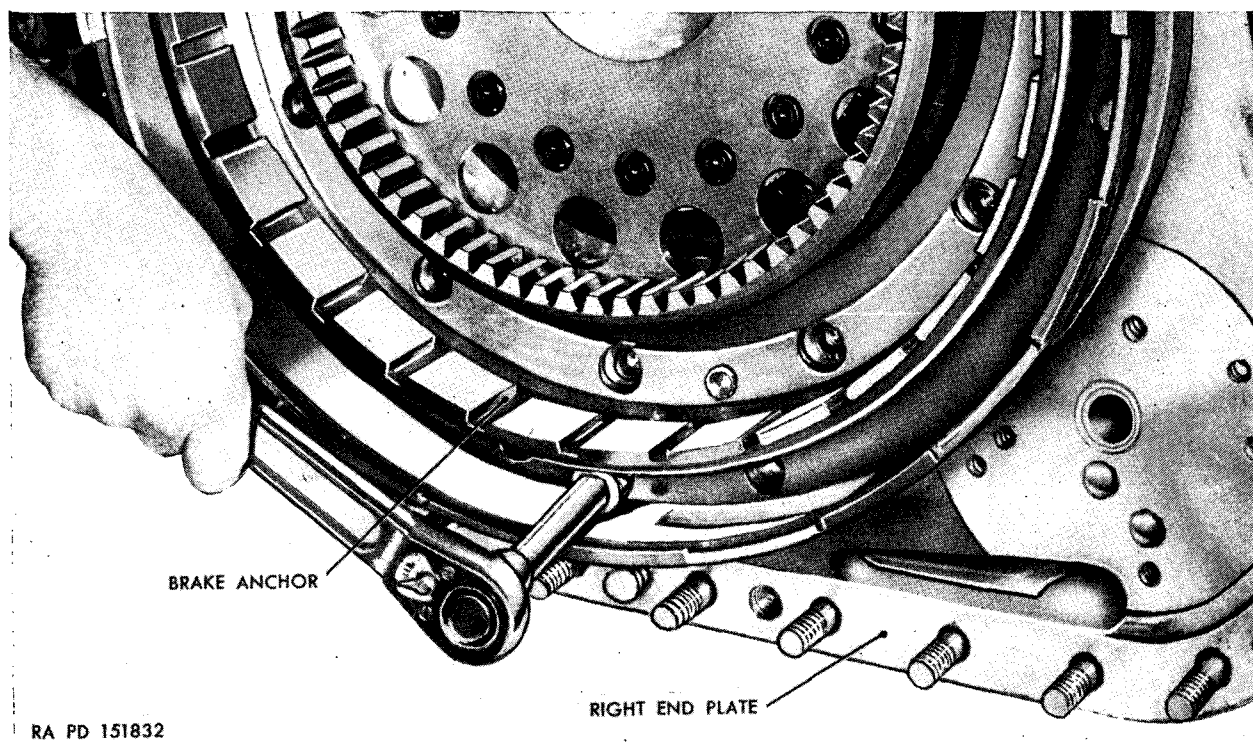


Figure 93. Removing or installing brake-anchor bolts.

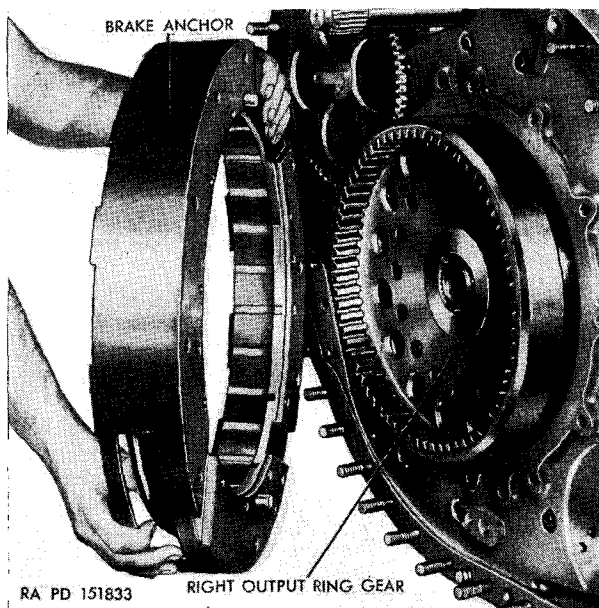


Figure 94. Removing or installing brake anchor.

Remove 13 bolts and washers from the range control valve body, using a $\frac{1}{16}$ inch wrench. Lift the range control valve body off the right housing and remove the gasket (fig. 99).

- (2) Using a $\frac{1}{2}$ -inch socket, remove 10 bolts securing the steering-valve body to the steering-valve-body plate.

Caution: Be sure to hold the valve body when removing the last bolt.

Remove the steering valve body and the gasket from the plate (fig. 100). Using a $\frac{1}{2}$ -inch wrench, remove the five bolts and washers from the valve-body plate, being careful not to drop the plate. Remove the plate and the gasket from the right housing (fig. 101).

k. SEPARATION OF THE LEFT AND RIGHT HOUSINGS. Remove the cotter pins from the two castellated nuts in the flywheel housing. Remove the two nuts, bolts and washers (fig. 102). Bend down the tabs on the lock plate (fig. 103) and, using a $\frac{1}{2}$ -inch wrench, loosen the nuts from the fan-and-pump drive assembly. It is not necessary

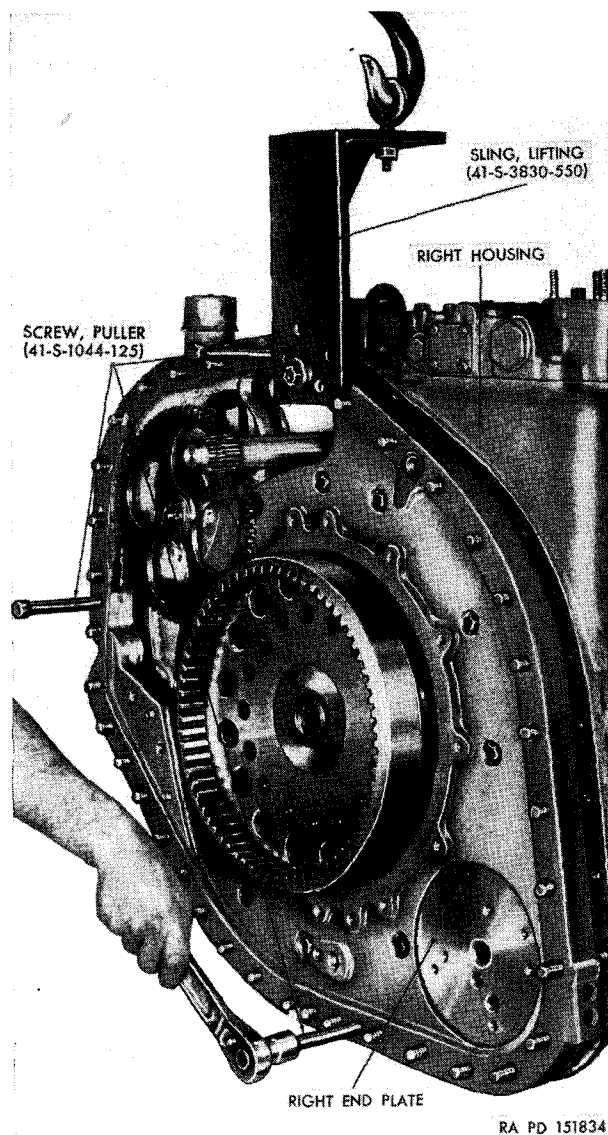


Figure 95. Lifting sling and puller screws attached to right end plate.

to remove these nuts. Using a $\frac{3}{4}$ -inch wrench, remove 32 jam nuts, nuts, and washers, and 13 bolts and washers from the split line of the housings. Using three puller screws (41-S-1044-125), separate the right housing from the left housing (fig. 104). Using lifting sling (C7083778), lift the right housing, being careful not to allow it to bind on the left housing studs (fig. 105).

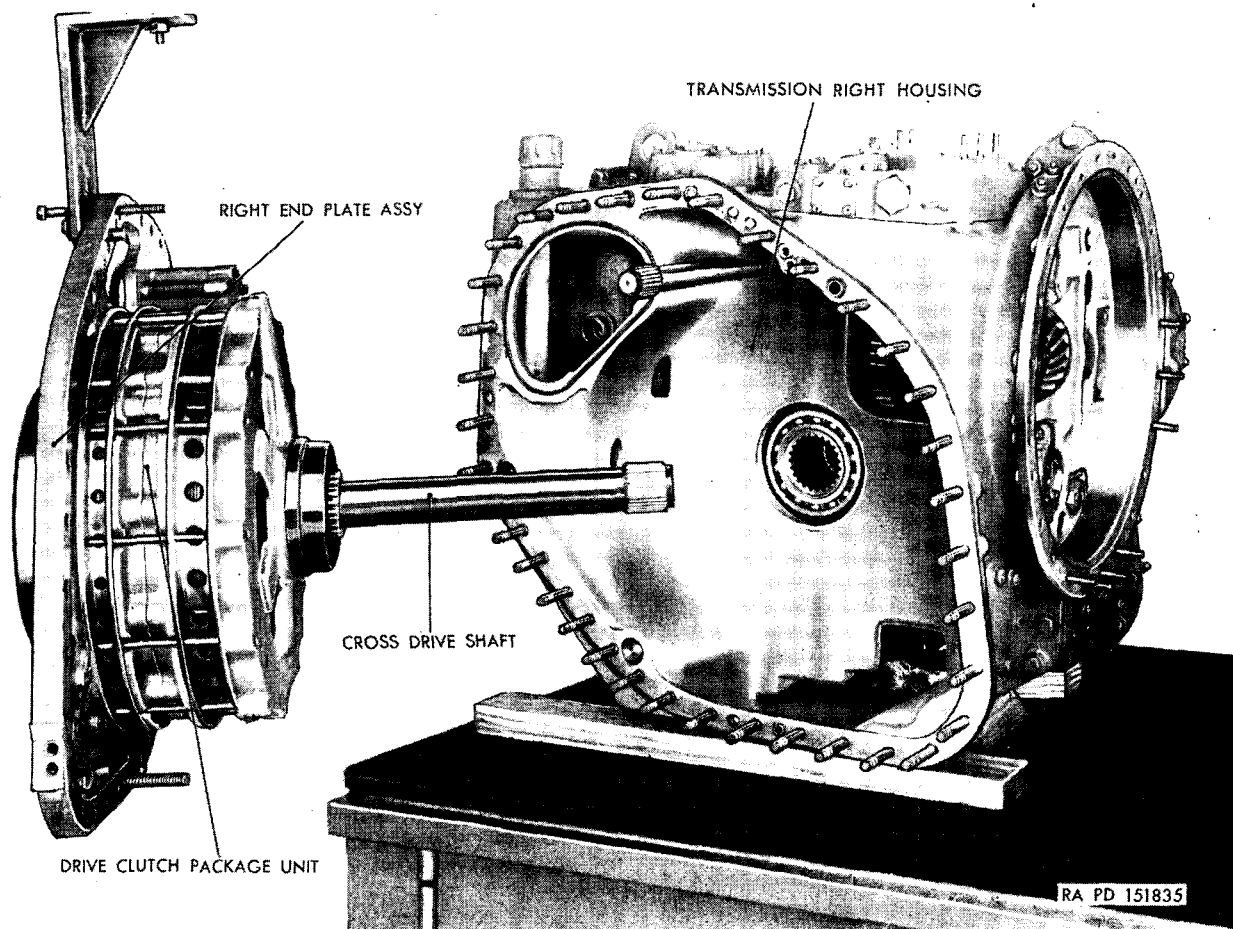


Figure 96. Removing or installing right-end-plate assembly using lifting sling (41-S-8830-550).

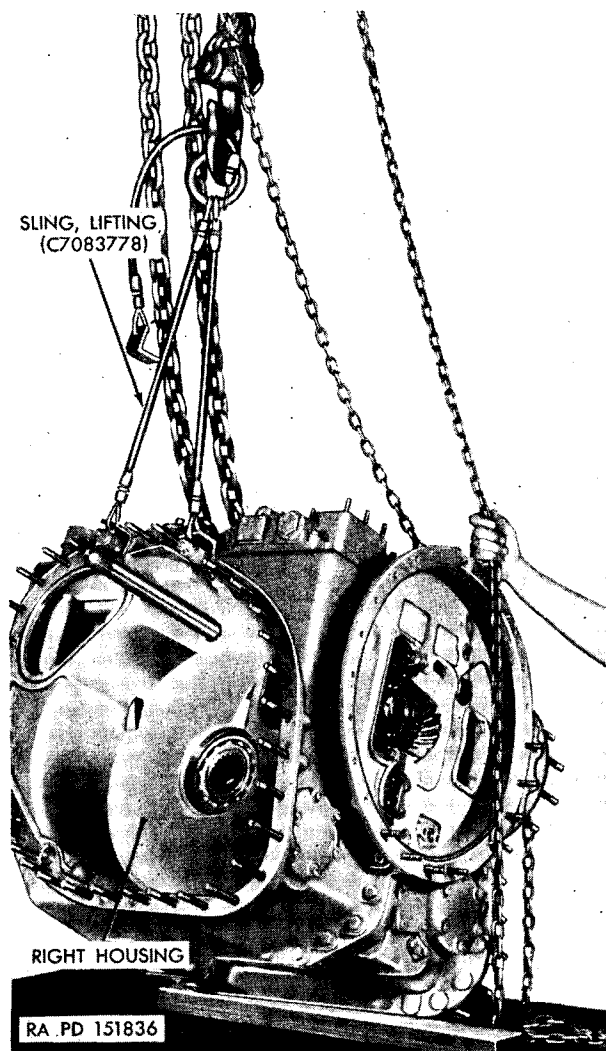


Figure 97. Tipping transmission housings.

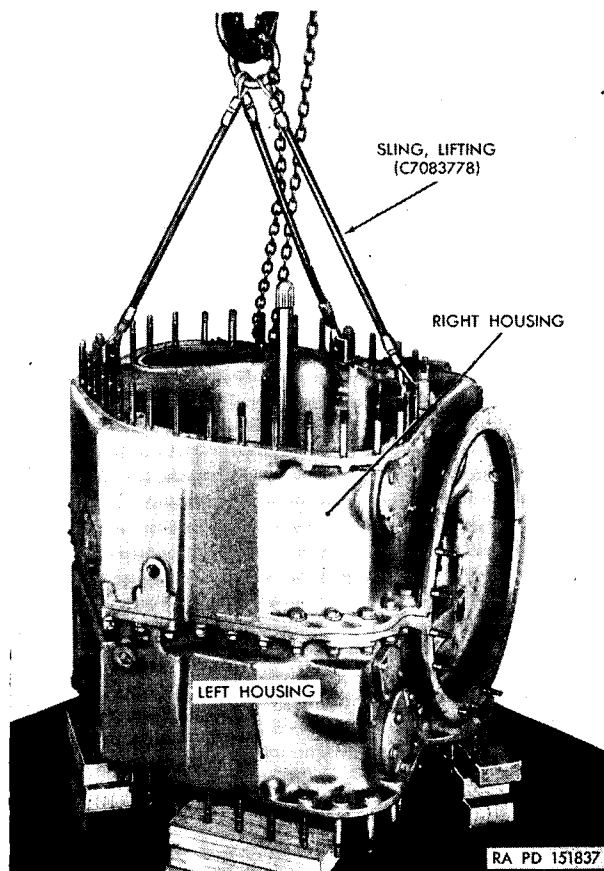


Figure 98. Transmission housings resting on blocks.

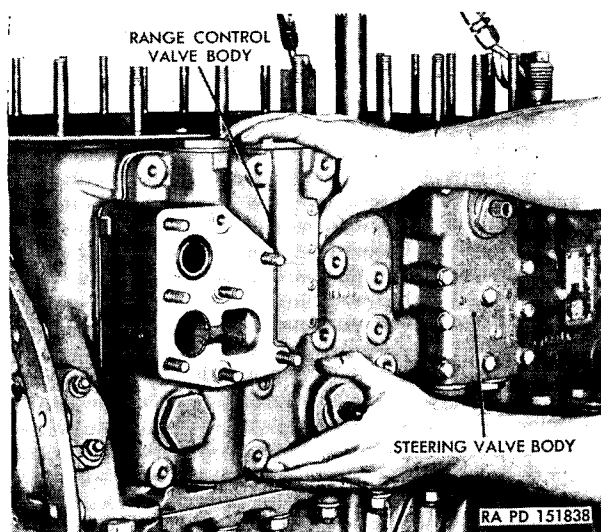


Figure 99. Removing or installing range-control-valve-body assembly.

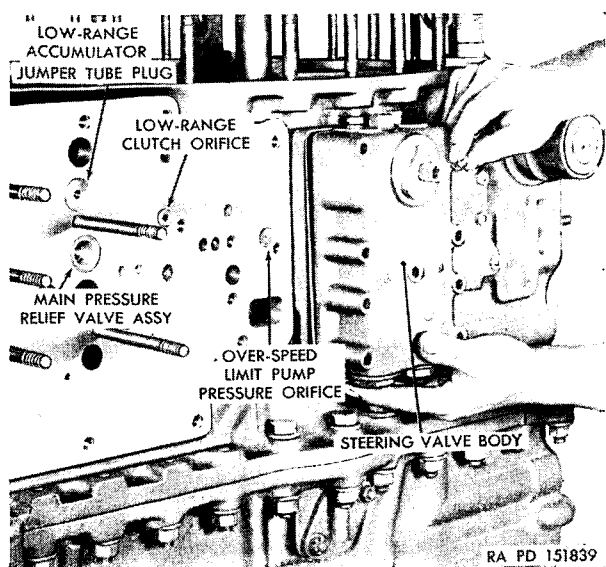


Figure 100. Removing or installing steering-valve-body assembly.

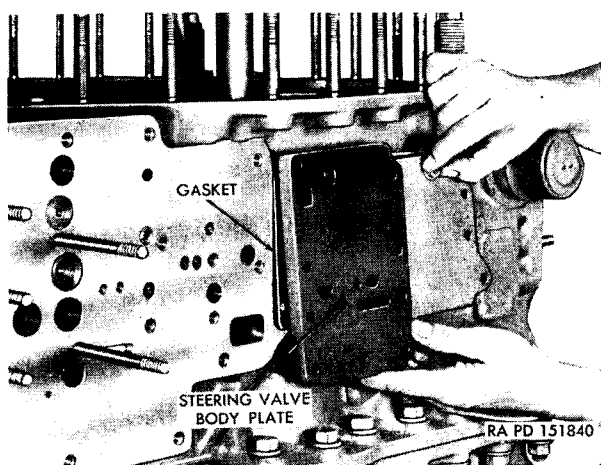


Figure 101. Removing or installing plate and gasket.

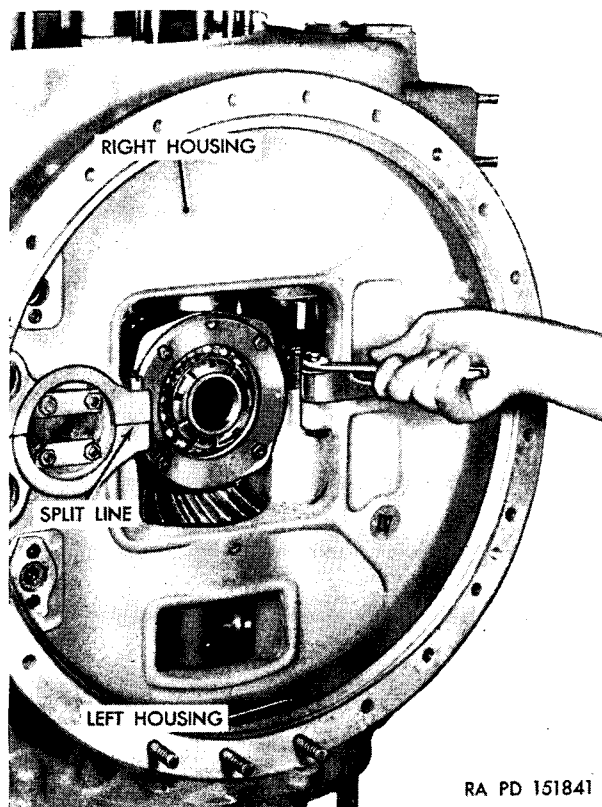


Figure 102. Removing or installing split-line castellated nuts.

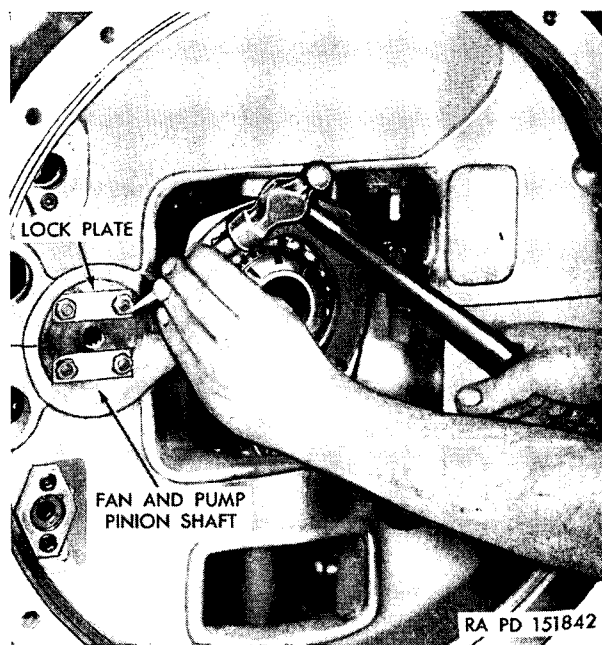


Figure 103. Bending lock plate tabs.

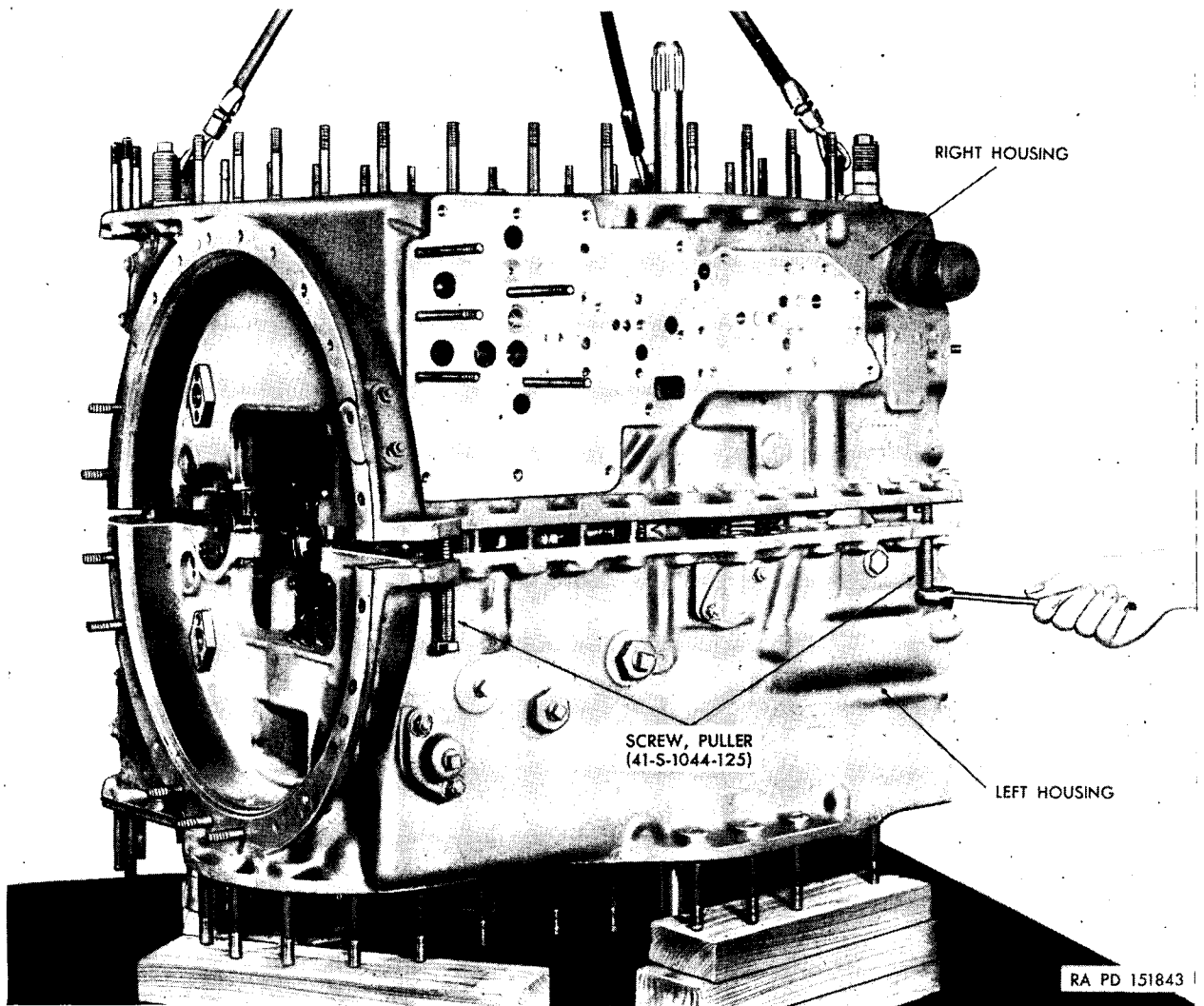


Figure 104. Separating housings using puller screws.

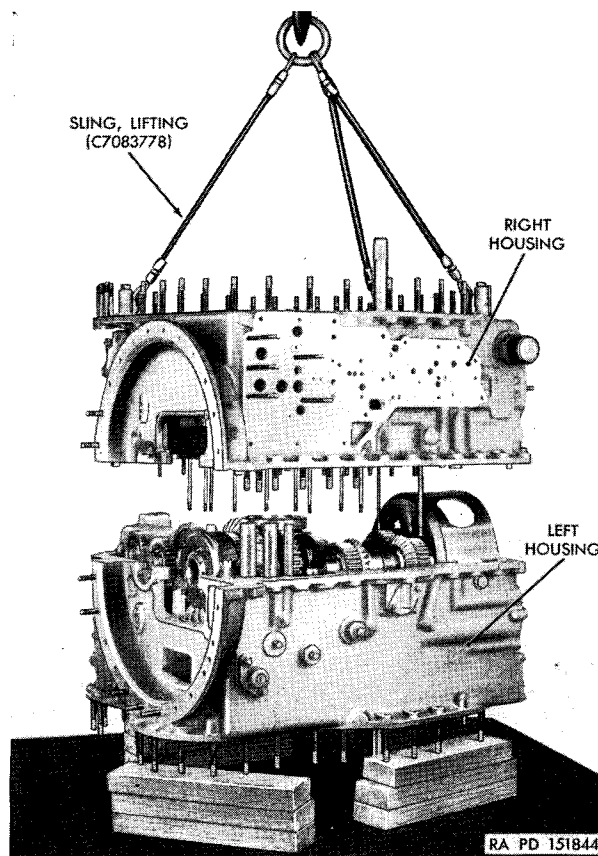


Figure 105. Removing or installing right housing.

Section III. REBUILD OF STEERING CLUTCH PACK

24. Disassembly of Steering Clutch Pack

a. Remove one $\frac{1}{4}$ -inch setscrew, using a screwdriver, from the face of the steering-clutch-shaft-rear-bearing lock screw (fig. 106). Remove the steering-clutch-shaft-rear-bearing lock screw, using a $1\frac{3}{4}$ -inch wrench (fig. 107).

b. Remove the clutch assembly (fig. 108) from the vise and place it, shaft up, on two 2 x 4 wooden blocks. Using a $\frac{1}{2}$ -inch socket, remove the 10 long bolts that secure the clutch hub and piston assembly to the steering clutch shaft (fig. 109). With the aid of two $\frac{5}{16}$ -24 jack screws, separate the shaft assembly from the clutch hub assembly (fig. 110). Remove the shaft assembly. Lift the eight right steering clutch disks off the right steering clutch inner ring (fig. 111). With a soft hammer, gently tap the right steering clutch inner ring until it is free from the four dowel pins in the

clutch inner hub. Remove the right steering clutch inner ring.

Note. At this point, turn the assembly over on the blocks. The disassembly will continue from the left steering end.

c. Remove the gasket from the oil transfer sleeve assembly. Thread two $\frac{5}{16}$ -inch steering clutch bolts into the oil transfer sleeve so that the sleeve can be lifted from the clutch inner hub. Using pliers (41-P-1992-36), remove the snap ring from the oil transfer sleeve (fig. 112). Using a drift, gently tap the steering-clutch-rear bearing out of the oil transfer sleeve (fig. 113). The spacer will fall out with the bearing. Remove the three hook-type oil seal rings from the oil transfer sleeve assembly (fig. 114). Separate the steering-clutch-backing plate from the inner hub assembly, using two $\frac{5}{16}$ -24 jack screws (fig. 115).

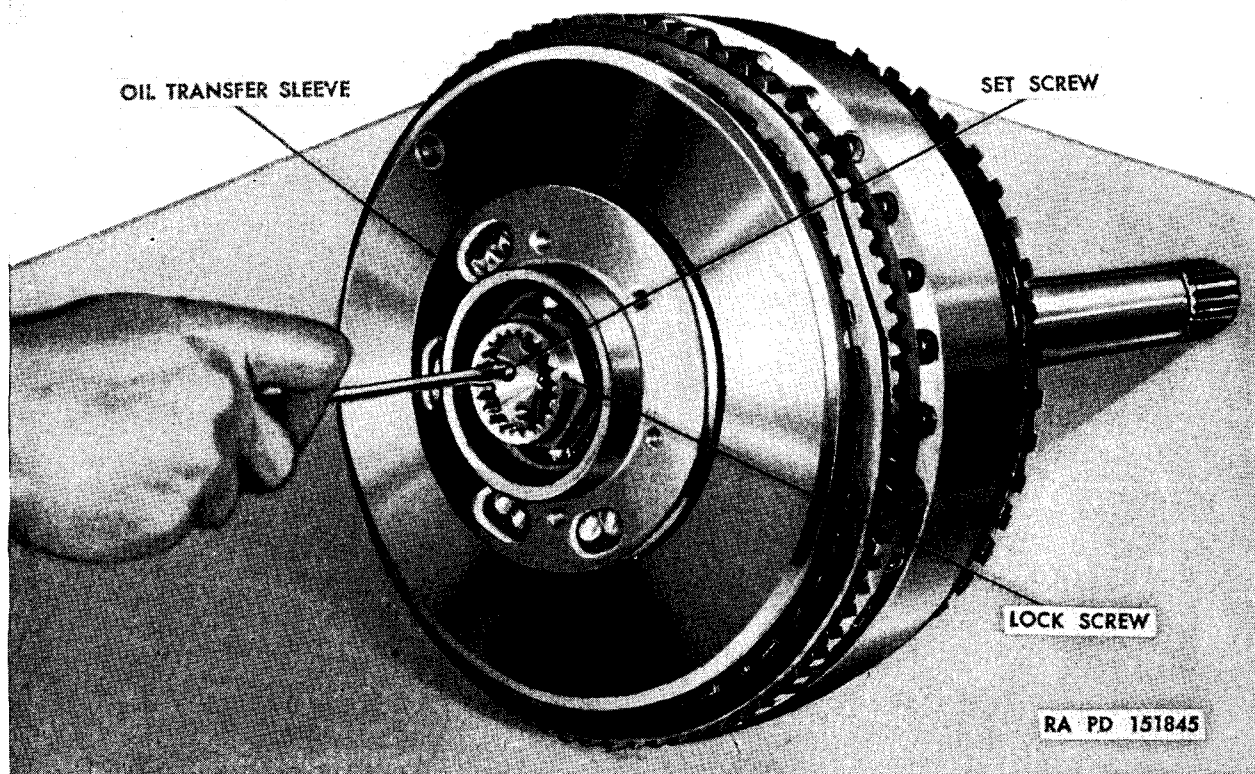


Figure 106. Removing or installing setscrew.

d. Remove the left-steering-clutch outer ring from the left-steering clutch pack. Remove the eight left-steering-clutch disks from the left-steering-clutch hub. With a soft hammer, gently tap the left-steering clutch inner ring from the four dowel pins in the clutch-inner hub.

e. Using a $\frac{5}{16}$ -inch wrench, remove the 30

piston assembly screws holding the left- and right-steering-clutch pistons (fig. 116).

Note. The screws are threaded into the steering clutch piston lock ring, which will drop to the blocks when all the screws are removed.

Lift off the left-steering-clutch piston (fig. 117). Remove the steering-clutch-piston lock ring from beneath the right-steering-clutch piston assembly. Remove the 24 steering-clutch-piston return springs from the spring guide pins on the clutch inner hub. Using a soft hammer, tap the steering-clutch inner hub assembly to loosen it and lift it out of the right-steering-clutch piston (fig. 118). Be careful with the two lip-type seals and one "O" ring gasket. Remove the seals, lube valve assemblies, and spring guides only if they are defective. Remove the 24 steering-clutch-piston return springs from the right steering clutch piston (fig. 119).

25. Cleaning

a. GENERAL. Clean thoroughly all parts of the transmission, except any type of bearing, either with a dry-cleaning solvent, volatile mineral spirits

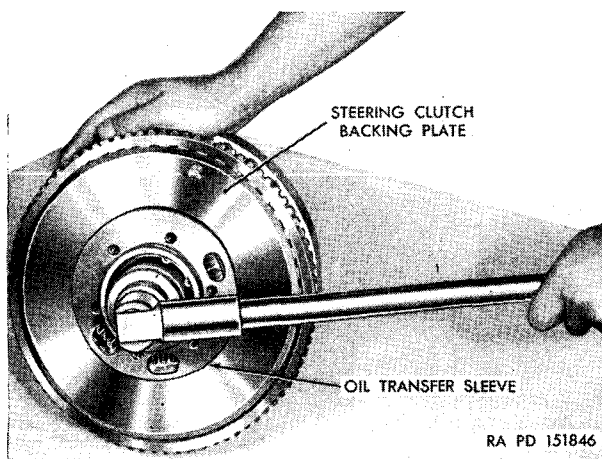


Figure 107. Removing or installing lock screw.

or by the steam-cleaning method. Dry all parts cleaned in dry-cleaning solvent or volatile mineral spirits by playing an air stream on the parts until the solvent has evaporated. Dry steam-cleaned parts with compressed air, or allow them to air-dry. Examine housings, cases, and other parts carefully for grit, dirt, or abrasives after cleaning and clean again if necessary. Clean all oil passages by working a wire back and forth through the passages and by flushing them with cleaning solvent or volatile mineral spirits. Dry them with compressed air.

b. CLEANING OF BEARINGS. Wash bearings thoroughly in clean dry-cleaning solvent or volatile mineral spirits. Oil them with engine oil (OE 30) before inspection. If bearings are particularly dirty or filled with hardened grease, soak them in the solvent for one hour to loosen the dried or caked material. Then flush the solvent back and forth between the races to clean dirt, grit, and abrasives from the bearing.

Note. Never dry bearings with compressed air. Do not spin bearings unless they are lubricated.

c. PREVENTING ENTRANCE OF DIRT IN BEARINGS. Dirt or grit in ball bearings is usually responsible for bearing failures; therefore be careful to keep bearings clean during installation or removal. Observe the following rules. They will do much to insure maximum bearing life.

- (1) Do not remove new bearings from their wrappers until ready to install.
- (2) Do not clean out grease in which bearings are packed.
- (3) Do not lay bearings on a dirty bench; place them on clean paper.
- (4) If an assembly is not to be completed immediately, wrap or cover exposed bearings with clean paper or cloth to keep out dust.

26. Inspection and Repair

a. GENERAL. All parts of the transmission must be carefully inspected. Refer to chapter 5, Serviceability Standards, for all minimum and maximum clearances and wear limits.

b. HOUSINGS AND OTHER CAST PARTS.

- (1) Inspect bores for wear, grooves, scratches, and dirt. Remove burs and scratches with crocus cloth. Remove any foreign matter. Replace parts that are grooved or deeply scratched.

- (2) Inspect all oil passages for obstructions; if found, remove them.
- (3) Inspect mounting faces for burs, scratches, nicks, and foreign matter; if found, remove with crocus cloth or a soft stone. If scratches are deep, replace the defective part.
- (4) Inspect all threaded openings for damaged threads; if found, chase threads with the correct size tap.
- (5) Inspect all cast parts for cracks; if found, replace the defective part.
- (6) Inspect all studs for damage or looseness; if defective, replace with oversize studs, available in 0.003-, 0.006-, and 0.009-inch oversizes.
- (7) Inspect dowels for damage or looseness, if defective, replace them. If a new dowel does not fit tightly, rebore and sleeve the dowel hole to the original manufacturing specifications.
- (8) Inspect dowel holes for wear due to relative movement between mating parts. If dowel holes are worn, rebore and sleeve the hole to the original manufacturing specifications.
- (9) Inspect all machined surfaces for damage which could cause oil leakage; if found, rework or replace the defective part.

c. ROLLER OR BALL BEARINGS.

- (1) Inspect bearing for roughness of rotation; if found, replace the bearing.
- (2) Inspect bearings for scored, scratched, cracked, pitted, or chipped races, and for indication of excessive wear of rollers or balls. If defective, remove the bearing.
- (3) Inspect the defective bearings' housing and/or shaft for grooved, burred or galled conditions which would indicate that a bearing has been turning in its housing or on its shaft. If damage cannot be repaired with crocus cloth, replace the damaged part.

Note. When replacing a bearing on a shaft, heat the bearing to 300 degrees on an electric hot plate or in an oil bath. Coat the shaft with white lead and use an arbor press, whenever possible, to seat the bearing. If possible, when replacing a bearing in a gear or housing, heat the part into which the bearing is to be fitted and/or chill the bearing. Coat the mating surfaces with white lead and use the proper size replacer, if available, and an arbor press to

A—STEERING CLUTCH BACKING PLATE GM-6763989
 B—LEFT STEERING CLUTCH OUTER RING GM-6765298
 C—INTERNAL SPLINED STEEL DISK (LEFT STEERING CLUTCH) (4) GM-6765658
 D—STEERING CLUTCH ASSEMBLY GM-6765398
 E—LEFT STEERING CLUTCH INNER RING ASSEMBLY GM-6765301
 F—LEFT AND RIGHT PISTON ASSEMBLIES
 G—RIGHT STEERING CLUTCH INNER RING ASSEMBLY GM-6765302
 H—INTERNAL SPLINED STEEL DISK (RIGHT STEERING CLUTCH) (4) GM-6765658
 J—EXTERNAL SPLINED BRONZE DISK (RIGHT STEERING CLUTCH) (8) GM-6765659
 K—STEERING CLUTCH SHAFT GM-6765378
 L—SHAFT BOLT (10) GM-6764027
 M—RING GM-6764025
 N—LUBE OIL ORIFICE GM-6765288
 P—STEERING CLUTCH PISTON LOCK RING GM-6764079
 Q—SLEEVE GM-6765339
 R—RIGHT STEERING CLUTCH PISTON GM-6764060
 S—LIP-TYPE SEAL RING GM-6765569
 T—STEERING CLUTCH INNER HUB GM-6764015
 U—SLEEVE GM-6764003
 V—“O” RING GASKET GM-6765573
 W—LIP-TYPE SEAL RING GM-6765569
 X—LEFT STEERING CLUTCH PISTON GM-6764062
 Y—SLEEVE GM-6765339
 Z—WASHER (30) GM-6763160
 AA—PISTON ASSEMBLY SCREW (30) GM-6764078
 BB—PISTON RETURN SPRING (24) GM-6765401
 CC—SPRING GUIDE PIN (24) GM-6765411
 DD—NUT (24) GM-6765412
 EE—PISTON RETURN SPRING (24) GM-6765401
 FF—SPRING (8) GM-6760328
 GG—LUBE VALVE (8) GM-6760317
 HH—SEAT (8) GM-6760306
 JJ—PIN (8) GM-6760307
 KK—DOWEL PIN (2) GM-6764932

Figure 10S—Continued.

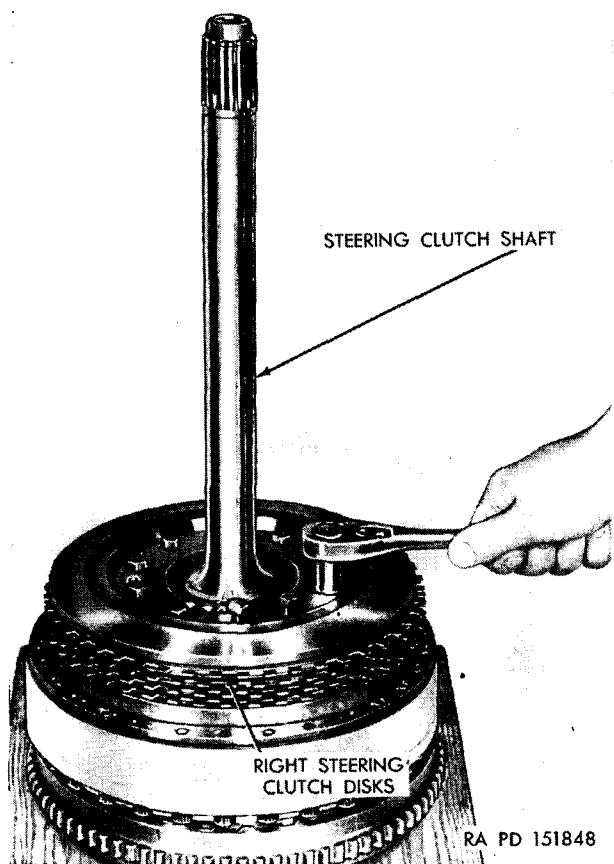


Figure 109. Removing or installing shaft bolts.

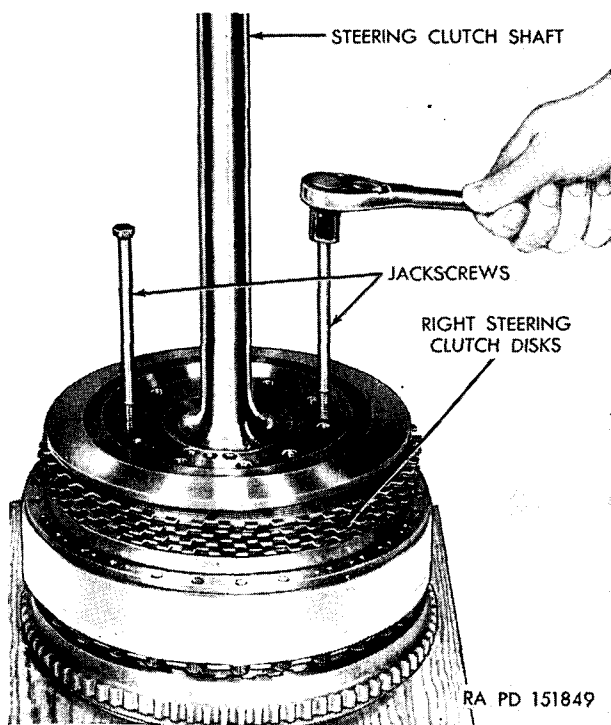


Figure 110. Removing steering clutch shaft, using jack screws.

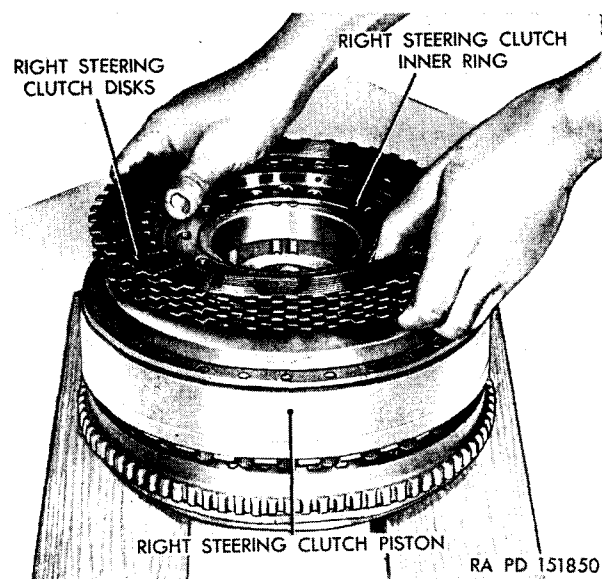


Figure 111. Removing or installing right-steering-clutch pack.

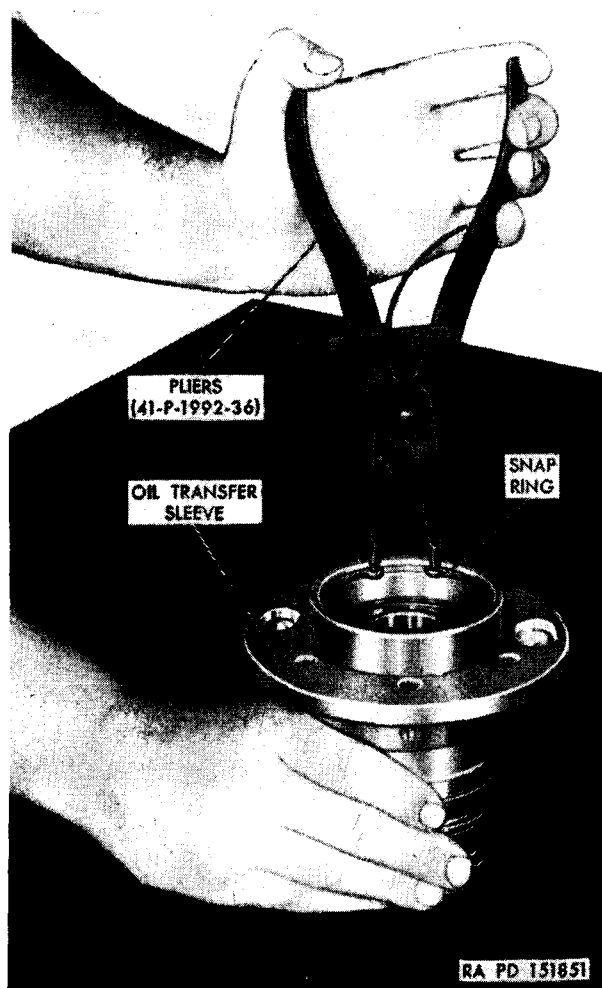


Figure 112. Removing oil-transfer sleeve snap ring.



Figure 113. Removing steering clutch rear bearing.

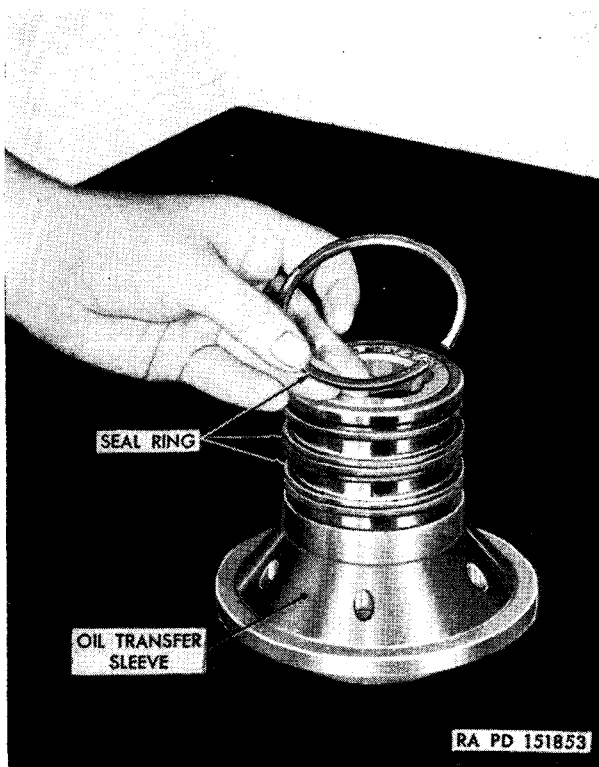


Figure 114. Removing hook-type seal rings.

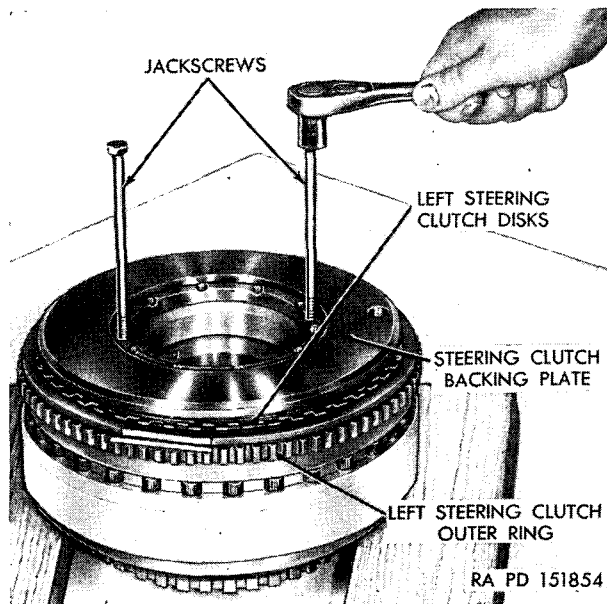


Figure 115. Removing backing plate using jack screws.

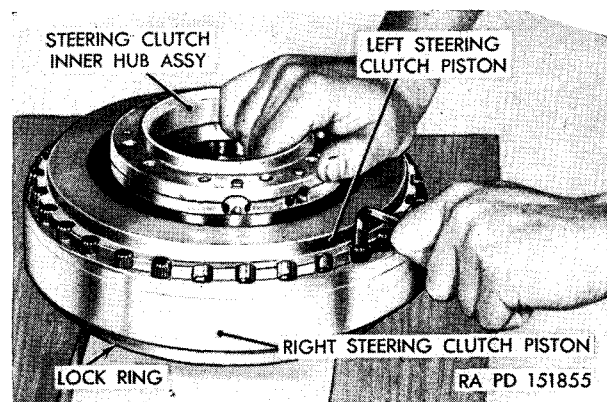


Figure 116. Removing or installing piston assembly screws.

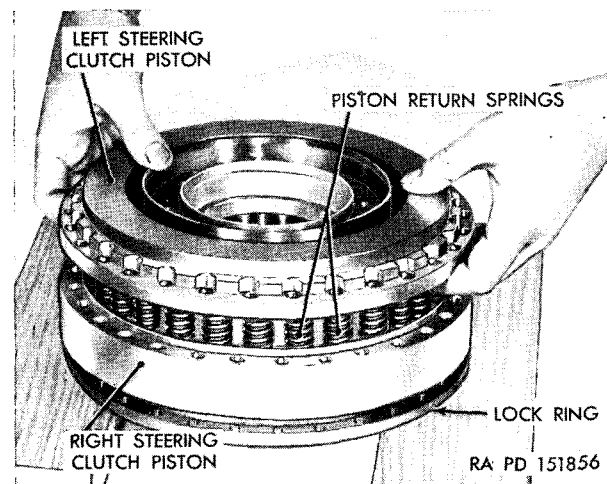


Figure 117. Removing or installing left-steering-clutch piston.

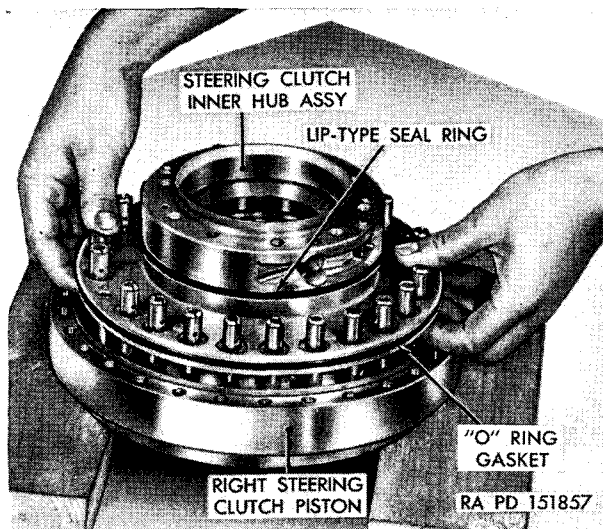


Figure 118. Removing or installing steering-clutch inner hub.

seat the bearing. If a bearing must be removed or installed without a replacer, be careful to press or drive only on the race which is adjacent to the mounting surface. Do not drive or press on the balls or rollers or on the unsupported race.

d. NEEDLE BEARINGS. Inspect the bearing for free rotation, broken, or missing rollers and tight fit in the bore. If defective, replace bearing using the proper size replacer.

Note. Do not remove needle bearings unless they are defective. Removal will usually fail the bearing.

e. BUSHING. Inspect bushings for roundness, scores, burs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burs and sharp edges with a scraper or knife blade. If the bushing is out of round, deeply scored or excessively worn, replace it using the proper size replacer.

Note. Sometimes it is necessary to cut out a defective bushing. When performing this operation, be careful not to damage the bore into which the bushing fits.

f. OIL SEALS AND GASKETS.

- (1) Inspect hook-type seal rings for excessive wear or damage. Replace if defective.
- (2) Inspect "O" ring gaskets for cuts and hardness; if found, replace them.
- (3) Inspect lip-type seal rings for cuts and hardness; if found, replace seal rings making sure the seal is properly installed.

g. GEARS.

- (1) Inspect gears for scuffed, nicked, burred, or broken teeth. If the defects cannot

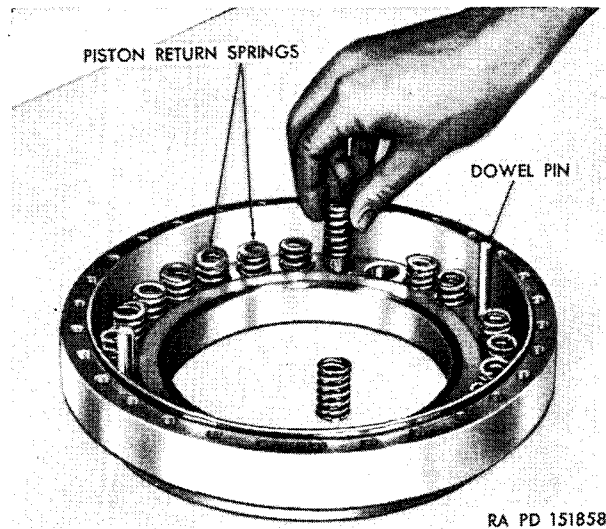


Figure 119. Removing or installing steering-clutch-piston return springs.

be removed with a soft stone, replace the gears.

- (2) Inspect gear teeth for wear which may have destroyed the original tooth shape; if found, replace the gear.
- (3) Inspect the thrust faces of gears for scores, scratches, and burs; if found, remove them with a soft stone. If scores and scratches cannot be removed, replace the gear.

h. SPLINED PARTS. Inspect parts for stripped, twisted, chipped, or burred splines. Remove any burs with a soft stone. Replace parts if other defects are found.

i. CLUTCH, BRAKE AND PRESSURE PLATES.

- (1) Inspect bronze disks for deep scores, excessive wear, loose bronze facings, and embedded particles of metal. Replace any disks that are defective.
- (2) Inspect steel disks for flatness, heat discoloration, and cracks. If any of these defects are found, replace the disks.

Note. Each steel disk should have a cone of 0.015 to 0.018 inch.

- (3) Inspect all disks for burs and distortion of the tabs. If burs are found, remove them with a fine file. If tabs are distorted, replace the defective disks.

j. LOCK NUTS AND OTHER THREADED PARTS. Inspect parts for burred or damaged threads. Remove burs with a soft stone or file. Replace damaged parts.

k. **SNAP RINGS AND LOCK RINGS.** Inspect all snap rings and lock rings for nicks and distortion. Replace the part if these defects are found.

l. **SPRINGS.** Inspect all springs for broken or distorted coils; if found, replace the springs.

m. **STEERING CLUTCH INNER HUB ASSEMBLY.**

- (1) Refer to paragraph 94 for serviceability measurements and wear limits.
- (2) If the seals, lube valve assemblies, and/or spring guides in the inner hub are defective, they must be removed. To remove the lube valves, use pliers to remove the dowel pins and two screwdrivers (or a suitable knocker tool) to remove the valve seats from the inner hub. Two screwdrivers can be used to take the spring guides apart. Replace all defective parts.

27. Assembly of Steering Clutch Pack

a. Install 24 steering-clutch-piston return springs in the right piston (fig. 119). Make sure one "O" ring gasket, eight lube valve assemblies, and two lip-type seals are installed on the clutch-inner hub. With two pieces of 2 x 4 wood, block up the right-steering-clutch piston with the spring side up. Install the clutch-inner hub, with the chamfered end of the bore up, in the right-steering-clutch piston (fig. 118). Tap gently into place with a soft hammer. Install the 24 steering-clutch-piston return springs. Place them around the spring guides on the clutch-inner hub assembly.

b. With the steering-clutch-piston lock ring in place against the lower side of the right-steering-clutch piston, place the left-steering-clutch piston over the clutch-inner hub (fig. 117). Aline the two holes with the two dowel pins on the right-steering-clutch piston. Secure the two pistons together with 30 $\frac{5}{16}$ -inch piston assembly screws (fig. 116). Turn the assembly over. Install the right-steering-clutch-inner ring on the inner hub assembly, locating it on the four dowel pins (fig. 120). Turn the assembly over. Install the left-steering-clutch-inner ring on the clutch-inner hub, locating it on four dowel pins.

c. Install the left steering clutch pack. It consists of four steel internally splined disks and four bronze externally splined disks. Insert a steel disk first, then a bronze and alternate steel and bronze, ending with a bronze disk (fig. 121).

Note. All the steel disks should be installed with the cone toward the piston.

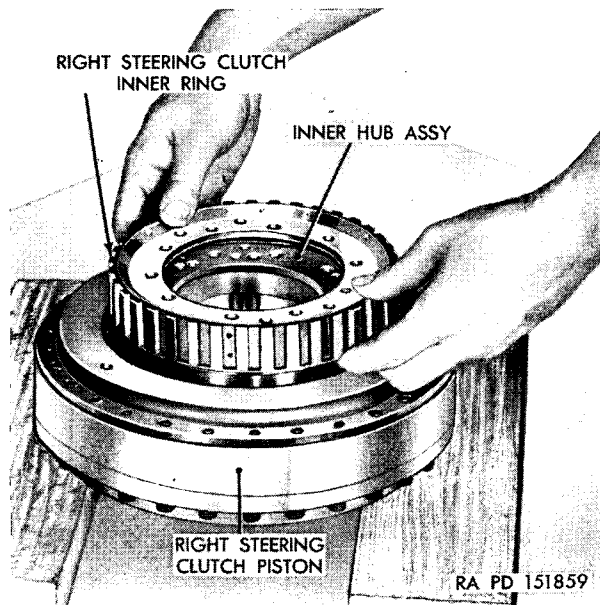


Figure 120. Installing right-steering-clutch-inner ring.

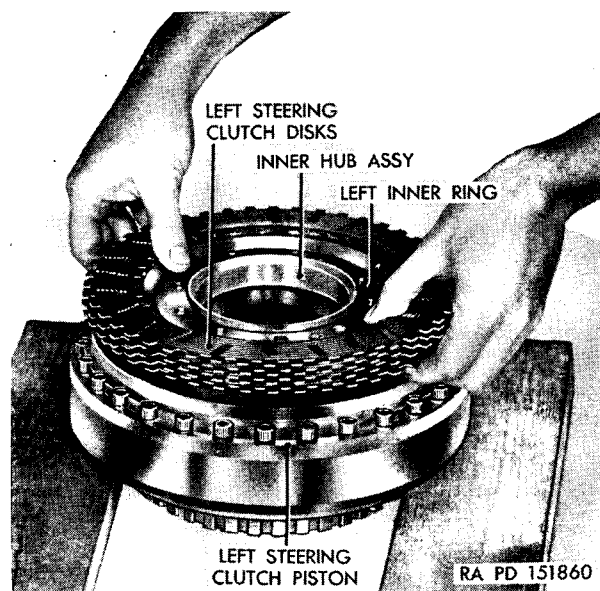


Figure 121. Installing left-steering-clutch pack.

Install the left-steering-clutch outer ring over the disk pack with the snap ring groove up (fig. 122). Install the steering-clutch-backing plate over the disk pack and inner hub assembly by tapping it in place on the inner hub. Index the plate until its holes aline with the bolt holes on the clutch-inner hub.

Note. Turn the assembly over on the blocks and continue from the right steering end.

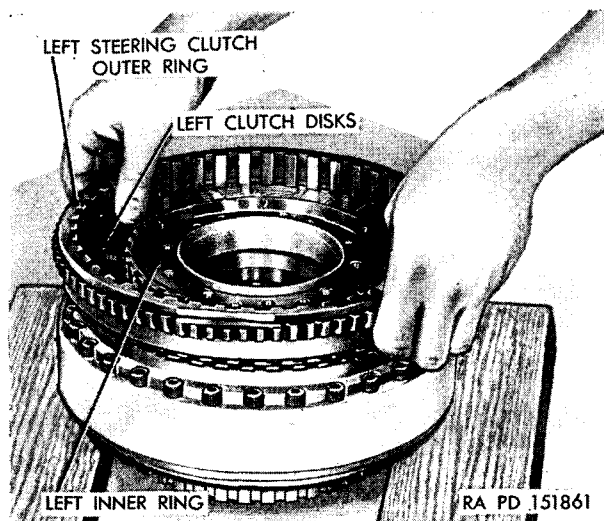


Figure 122. Installing left-steering-clutch-splined outer ring.

d. Install the right-steering-clutch pack (fig. 111). Use the same procedure and precautions as for the left-steering-clutch pack. Make sure the hook-type seal ring and lube oil orifice are in place in the steering clutch shaft. Install the steering clutch shaft. Aline the bolt holes and secure with ten $\frac{5}{16}$ -inch bolts (fig. 109). Make sure the three hook-type seal rings, gasket, steering-clutch rear bearing, spacer, and snap ring are in place on the oil-transfer sleeve. Lay the steering clutch assembly on its side and install the oil-transfer sleeve. Keep the oil transfer sleeve

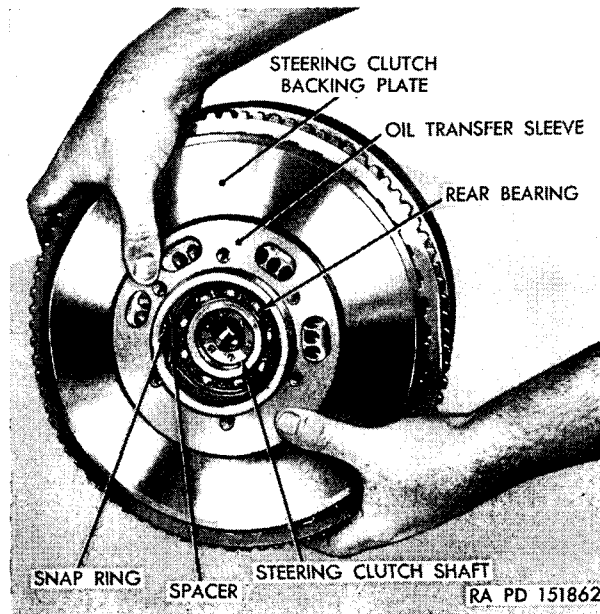


Figure 123. Installing oil transfer sleeve

aligned with the bore of the inner hub in order to prevent damage to the seal rings. Push the sleeve in far enough for the bearing to start on the shaft (fig. 123). Install the rear bearing lock screw, using a $1\frac{1}{4}$ -inch wrench (fig. 107). Apply 200 pound-feet torque. It may be necessary to torque a little more to aline a lock hole. Lock with a $\frac{1}{4}$ -inch setscrew, using a screwdriver (fig. 106). Stake in place.

Section IV. REBUILD OF PRESSURE CONTROL VALVE ASSEMBLY AND OIL FILTERS

28. Disassembly of Pressure Control Valve and Oil Filters

a. **PRESSURE CONTROL VALVE ASSEMBLY.** Remove the two jumper tubes from the assembly (fig. 124). Using a soft drift to depress the lubrication-control valve stop, remove the retaining snap ring with snap ring pliers (fig. 125). Remove the stop, lubrication control valve, and the spring. Use a soft drift to depress the brake-pressure-regulator-valve guide while using snap ring pliers to remove the retaining snap ring (fig. 126). Reduce the pressure on the guide and remove it. Remove the spring and the brake-pressure regulator valve.

b. **CONVERTER OIL FILTER.** Using a $\frac{5}{16}$ -inch wrench, remove the five bolts and washers which

secure the two shipping covers to the filter. Remove the two covers. With a $\frac{5}{16}$ -inch wrench, remove the three filter pack retaining bolts and washers from the oil filter pack assembly. Using two of the filter pack retaining bolts as jack screws, separate and remove the filter disks (the filter pack assembly) from the filter body (fig. 128).

c. **MAIN OIL FILTER.** Using a $1\frac{1}{2}$ -inch wrench, remove the oil filter relief valve assembly from the end of the filter tube (fig. 127).

d. **SUMP OIL FILTER.** Refer to paragraph 30e.

29. Cleaning

Refer to paragraph 25 for cleaning instructions.

30. Inspection and Repair

a. GENERAL. Refer to paragraph 26*a* through *l* for general inspection and repair procedure. Refer to paragraph 95 for serviceability measurements and wear limits.

b. PRESSURE CONTROL VALVE ASSEMBLY. Inspect the two jumper tubes and four "O" ring gaskets. Inspect the "O" ring gasket on the lubrication-control-valve stop. Inspect all other parts and replace any that are defective.

Note. Do not remove the lubrication-control valve sleeve (Y of fig. 124) from the valve body. If the sleeve is defective, replace the body and sleeve as an assembly. Do not remove the brake-pressure, regulator-valve seat (R of fig. 124) from the valve body cover. If the seat is defective, replace the cover and seat as an assembly.

If it is necessary, the valve body cover and gasket may be removed from the valve body by removing 10 bolts and washers from the cover.

c. CONVERTER OIL FILTER. Inspect the "O" ring gasket on each converter-body mounting pad. Inspect the converter filter body. Inspect the filter pack for any foreign matter not removed during cleaning and for damaged filter disks. If any defects are found, remove the nut from the end of the filter tube using a 1½-inch wrench. Remove the large washer. Remove the 31 small washers and 31 filter disks. Replace any defective parts. To assemble, install first a filter disk on the filter tube. Then install the washers and disks alternately, ending with a washer. Install the large washer and the nut. Secure the nut with locking wire.

d. MAIN OIL FILTER. Inspect the filter pack and the "O" ring gasket. If the filter pack must be disassembled, follow the procedure given in *c* above. Inspect the main oil filter relief valve assembly. If the valve assembly must be disassembled, place it in an arbor press and depress the spring retainer plate until the pressure is taken off the snap ring. Remove the snap ring, using snap ring pliers (fig. 129). Gradually reduce the pressure on the retainer plate and then remove the retainer plate, springs, and valve from

the retainer. Replace any defective parts. To assemble, install the relief valve in the retainer. Install the springs and retainer plate. Use an arbor press to compress the springs until the snap ring can be installed.

e. SUMP OIL FILTER. Inspect the sump oil filter pack (fig. 127). See *c* above for the disassembly procedure.

31. Assembly of Pressure Control Valve and Oil Filters

a. PRESSURE CONTROL VALVE. Install the gasket and cover on the valve body, if they have been removed, and secure them with nine long ¼-inch bolts and one short ¼-inch bolt. Install the brake-pressure regulator valve, spring, and guide into the bore in the valve-body cover, making sure that the valve stem goes into the valve guide. Depress the valve guide and install the snap ring (fig. 126). Install the lubrication-control-valve-spring, valve, and stop in the sleeve in the valve body.

Note. Be sure the "O" ring gasket is on the stop and that it is not defective.

Depress the stop and install the snap ring (fig. 125). Install two "O" ring gaskets on each of the two jumper tubes. Install the jumper tubes in pressure-control-valve body assembly.

b. CONVERTER OIL FILTER. Install the "O" ring gasket in the groove on the filter tube assembly. Install the tube assembly in the filter body. Secure the filter to the body with three ¾-inch bolts and washers. Torque the bolts 33 to 40 pound-feet. Install an "O" ring gasket in the groove on each of the two converter mounting flanges. Install the shipping covers on the flanges.

c. MAIN OIL FILTER. Install the "O" ring gasket on the filter tube assembly if it has been removed. Install and tighten the relief valve assembly on the end of the filter tube.

d. SUMP OIL FILTER. Install the "O" ring gasket on the assembly if it has been removed.

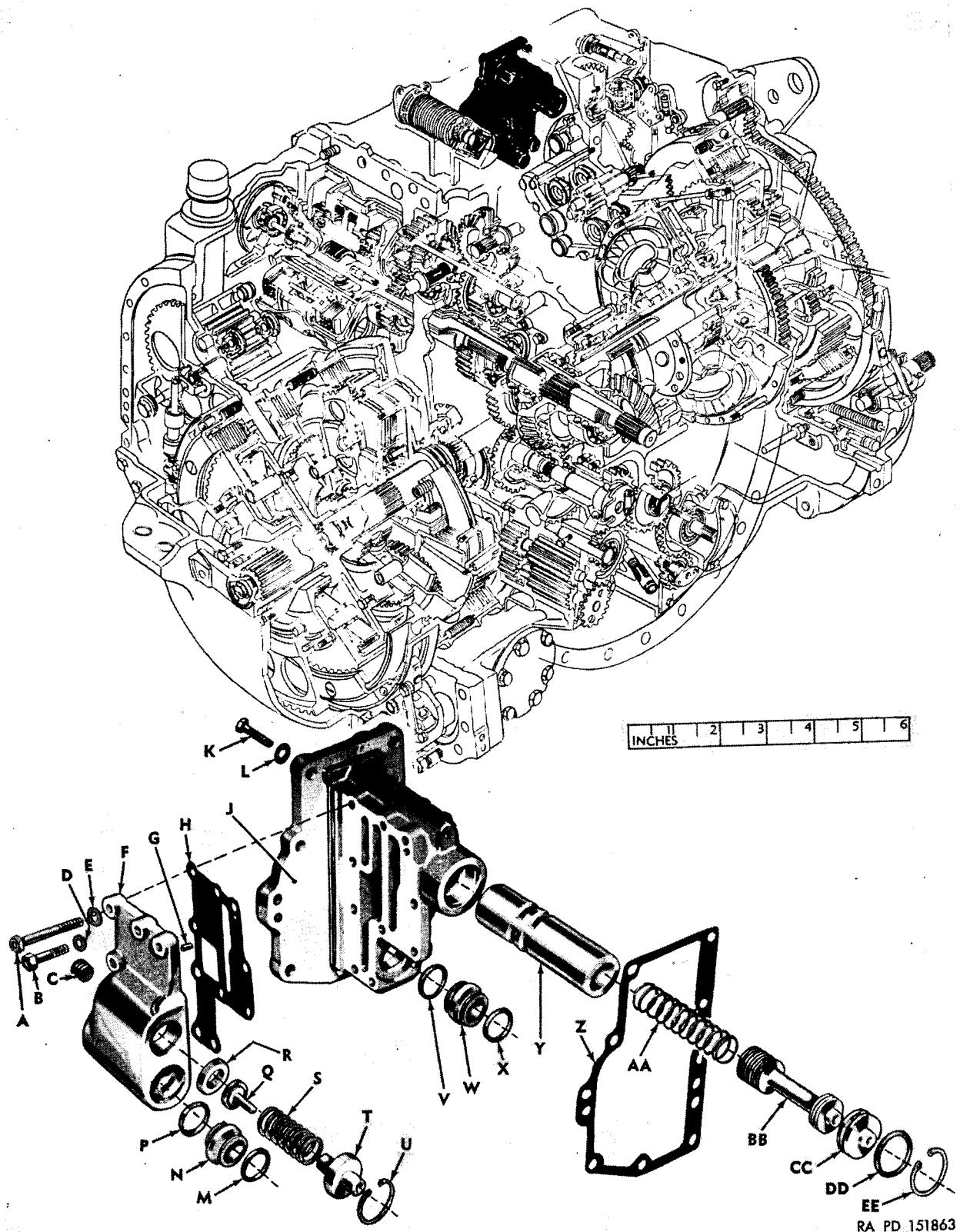


Figure 124. Pressure-control-valve assembly—exploded view.

A—BOLT (9) GM-221579
 B—BOLT GM-221574
 C—PLUG GM-444693
 D—WASHER GM-103339
 E—WASHER (10) GM-103339
 F—VALVE BODY COVER GM-6763808
 G—DOWEL (2) GM-141105
 H—GASKET GM-6763810
 J—PRESSURE CONTROL VALVE BODY 6763807
 K—BOLT (9) GM-429002
 L—WASHER (9) GM-103340
 M—“O” RING GASKET GM-6760478
 N—JUMPER TUBE GM-6762497
 P—“O” RING GASKET GM-6760478
 Q—BRAKE-PRESSURE REGULATOR VALVE GM-6766189
 R—BRAKE-PRESSURE-REGULATOR VALVE SEAT GM-6765416
 S—SPRING GM-6765415
 T—BRAKE-PRESSURE-REGULATOR-VALVE GUIDE GM-6765414
 U—SNAP RING GM-6761357
 V—“O” RING GASKET GM-6760478
 W—JUMPER TUBE GM-6762497
 X—“O” RING GASKET GM-6760478
 Y—LUBRICATION CONTROL VALVE SLEEVE GM-6763809
 Z—GASKET GM-6763811
 AA—SPRING GM-6765438
 BB—LUBRICATION CONTROL VALVE GM-6763821
 CC—LUBRICATION CONTROL VALVE STOP GM-6764590
 DD—“O” RING GASKET GM-6762127
 EE—SNAP RING GM-6704030

Figure 124—Continued.

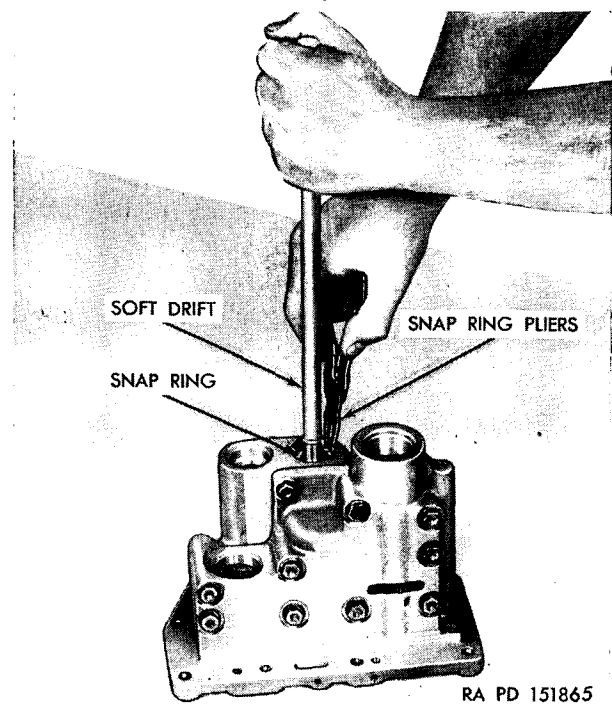
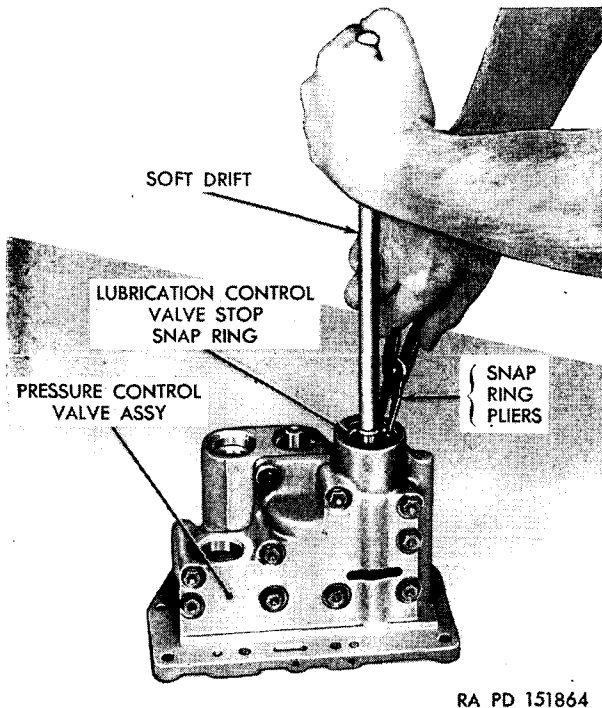


Figure 125. Removing or installing lubrication-control-valve stop snap ring.

Figure 126. Removing or installing brake-pressure-regulator-valve snap ring.

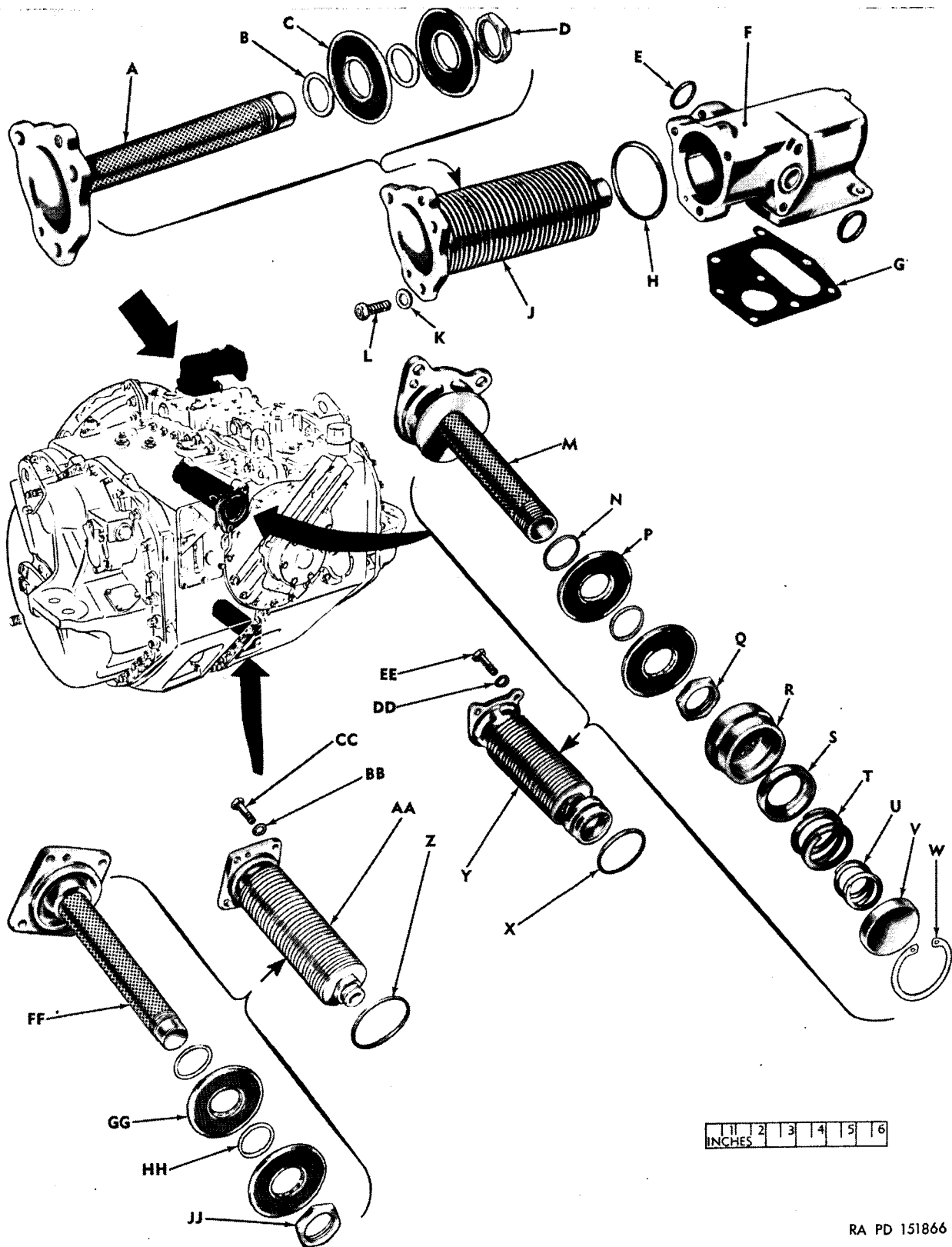


Figure 127. Oil filter assemblies—exploded view.

A—CONVERTER OIL FILTER TUBE ASSEMBLY GM-6765609
 B—WASHER (32) GM-6762003
 C—PACK ASSEMBLY (31) GM-6761495
 D—NUT GM-6761492
 E—“O” RING GASKET (3) GM-6760995
 F—CONVERTER OIL FILTER BODY ASSEMBLY GM-6765482
 G—GASKET GM-6760165
 H—“O” RING GASKET GM-6761626
 J—CONVERTER OIL FILTER PACK ASSEMBLY GM-6765467
 K—WASHER (8) GM-103341
 L—FILTER PACK RETAINING BOLT (8) GM-192226
 M—MAIN OIL FILTER TUBE ASSEMBLY GM-6764148
 N—WASHER (31) GM-6762003
 P—PACK ASSEMBLY (31) GM-6761495
 Q—NUT GM-6761492
 R—RETAINER GM-6764954
 S—OIL FILTER RELIEF VALVE GM-6764950
 T—OUTER SPRING GM-6764154
 U—INNER SPRING GM-6765759
 V—SPRING RETAINER PLATE GM-6764952
 W—RELIEF VALVE SNAP RING GM-6761846
 X—“O” RING GASKET GM-6761626
 Y—MAIN OIL FILTER ASSEMBLY GM-6763992
 Z—“O” RING GASKET GM-6761626
 AA—SUMP OIL FILTER ASSEMBLY GM-6764009
 BB—WASHER (4) GM-103340
 CC—BOLT (4) GM-221584
 DD—WASHER (3) GM-103341
 EE—BOLT (3) GM-221595
 FF—SUMP OIL FILTER TUBE ASSEMBLY GM-6764139
 GG—PACK ASSEMBLY (40) GM-6761498
 HH—WASHER (40) GM-6762003
 JJ—NUT GM-6761492

Figure 127—Continued.

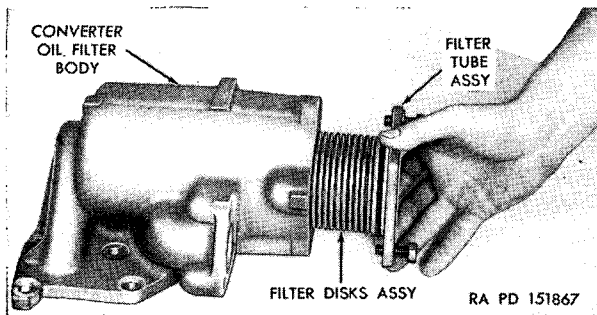


Figure 128. Removing converter oil filter.

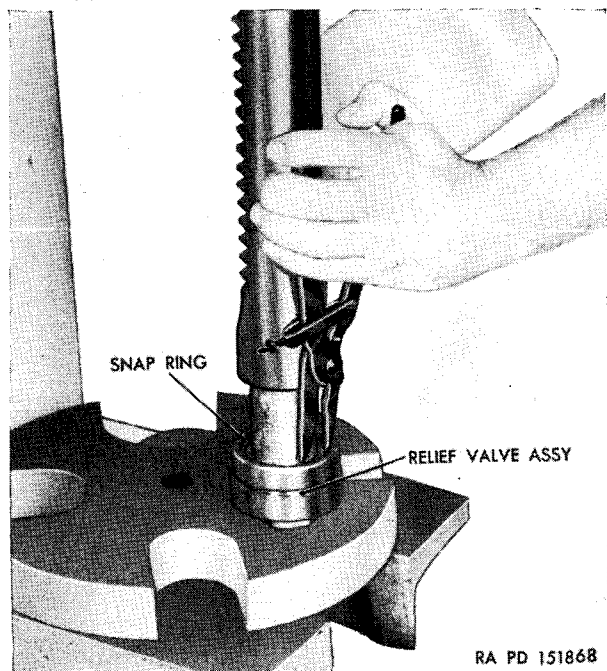


Figure 129. Removing or installing relief-valve snap ring.

Section V. REBUILD OF LEFT END COVER

32. Disassembly of Left End Cover

a. OUTER SIDE.

- (1) Remove the thrust washer from the left-output planet carrier. Lay the left end cover on the assembly table with the output flange up and remove the output-flange retainer screw, using a $\frac{7}{8}$ -inch

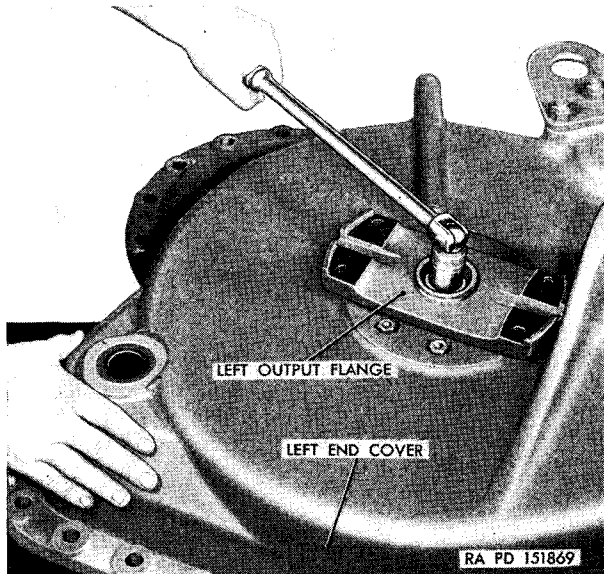


Figure 130. Removing or installing output-flange retainer screw.

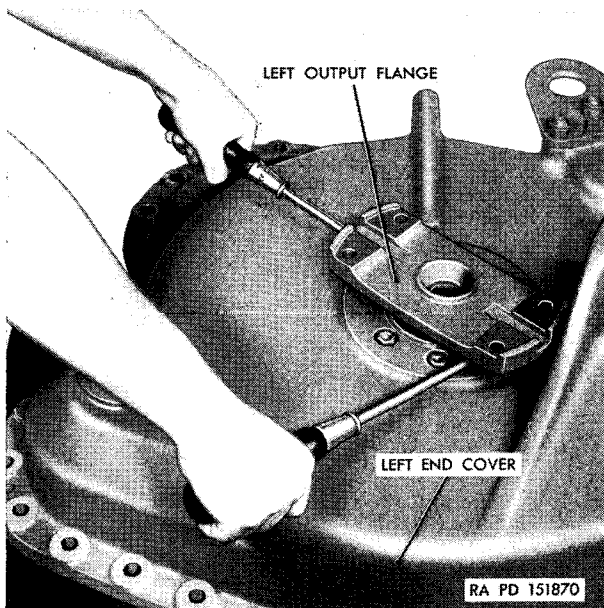


Figure 131. Removing left output flange.

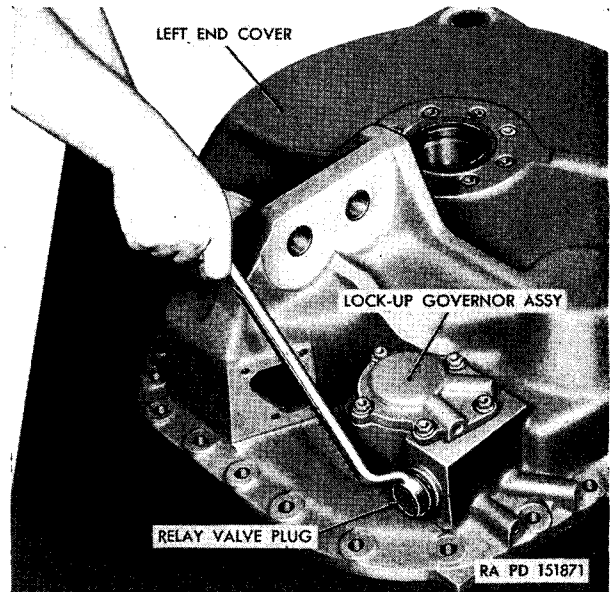


Figure 132. Removing or installing relay valve plug.

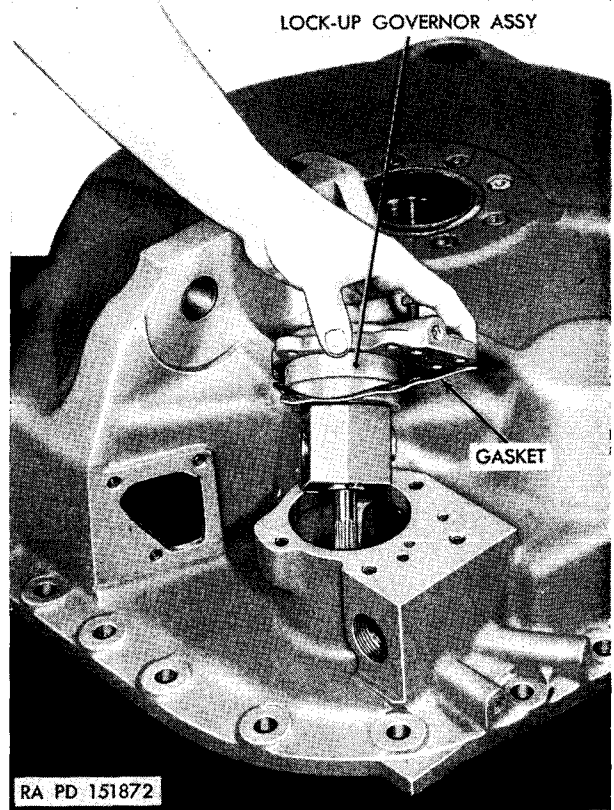


Figure 133. Removing or installing lock-up governor assembly.

socket (fig. 130). Using two screwdrivers, remove the left-output flange (fig. 131).

- (2) Lift the left end cover assembly from the output planet carrier and again place the end cover, split line down, on the assembly table.
- (3) Using a 1-inch wrench, remove the plug from the lock-up governor-relay valve (fig. 132). Remove the copper gasket, spring, retainer, and relay valve.
- (4) Using a ½-inch wrench, remove the five bolts and washers from the converter lock-up governor. Remove the lock-up governor cover and lock-up governor as a unit and remove the gasket (fig. 133).

b. INNER SIDE.

- (1) Turn the end cover over and lay it on the assembly table with the steering output pinion gear and the steering output gear exposed.
- (2) Using a ½-inch wrench, remove the five bolts from the steering output pinion inner bearing cage. Use one jack screw in the hole provided and pry with a screwdriver between the steering output

pinion and the inner bearing cage to remove the inner bearing cage from the steering pinion and bearing assembly (fig. 134).

- (3) Remove the steering output pinion and bearing assembly from the outer-bearing race. Then remove the race.
- (4) Lift the steering-output-gear and output-sun gear assembly from the end cover hub (fig. 135). Do not remove the end cover hub unless defective.

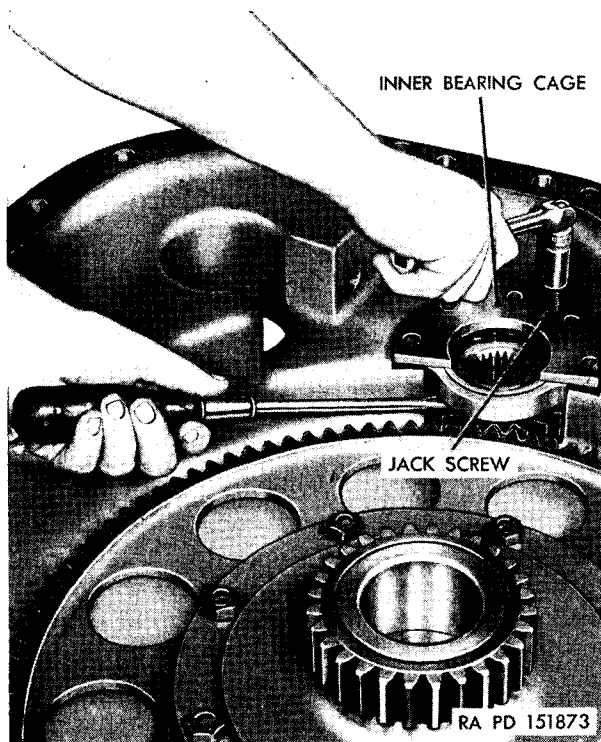


Figure 134. Removing inner bearing cage.

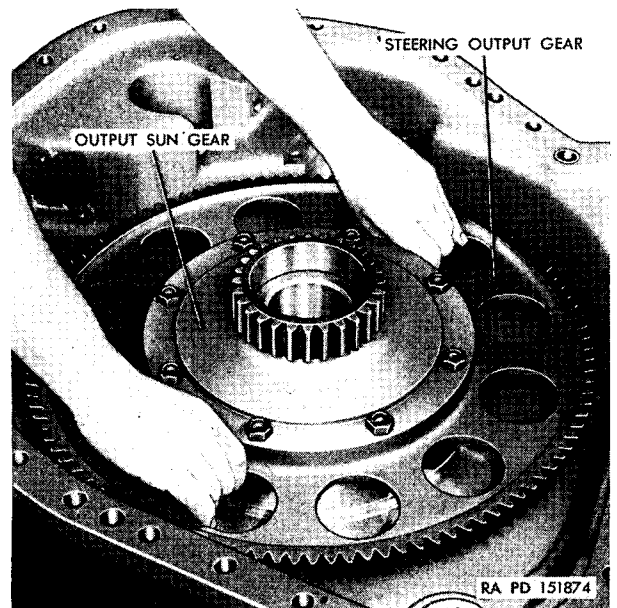


Figure 135. Removing or installing steering-output-gear and output sun gear assembly.

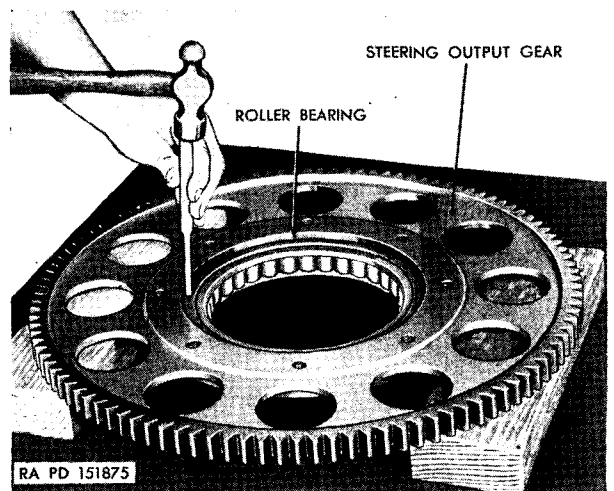


Figure 136. Removing roller bearing.

- (5) Remove the eight bolts from the steering output and output-sun gear assembly, using a $\frac{3}{4}$ -inch socket.
- (6) Using a soft hammer, separate the gears. Using a drift, tap on the outer race to remove the roller bearing from the steering-output gear (fig. 136).

c. OUTPUT PLANET CARRIER.

- (1) Using a $\frac{3}{8}$ -inch socket, remove the six bolts from the output planet carrier assembly.
- (2) Place the output planet carrier assembly on wooden blocks with the output shaft up. Rest the splined hub on the blocks.
- (3) Drive out of the planet carrier the four spindles which are attached to the output shaft, using a drift and a soft hammer. The pressure of the drift should be on the outer rim of the spindles (fig. 137).
- (4) Remove the output planet carrier from the output shaft (fig. 138).
- (5) Number the spindles and four containers so as to retain the pinion assemblies with their respective spindles.
- (6) Remove the planet pinions, spacers, thrust washers, and rollers from the spindles and place each assembly in the proper numbered container (fig. 139). Remove the large thrust washer from the output shaft.

33. Cleaning

Refer to paragraph 25 for cleaning instructions.

34. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for general inspection and repair procedure. Refer to paragraph 96 for serviceability measurements and wear limits.

b. END COVER HUB.

- (1) If the end cover hub (figs. 66 and 140) is defective, remove the eight bolts holding the hub to the end cover, using a $\frac{5}{16}$ -inch wrench. With the end cover on its split line, tap the hub out of the end cover from the outside. Be careful not to damage the "O" ring gasket.
- (2) Do not remove the bearing-inner race from the end cover hub unless it is defective. If it is necessary to remove it, the end-cover hub must be removed from the end cover first. Press the defective

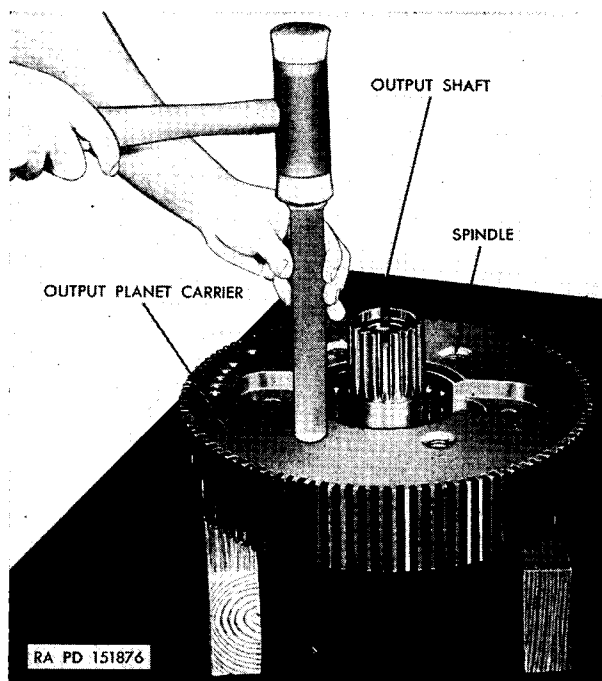


Figure 137. Tapping planet carrier spindle.

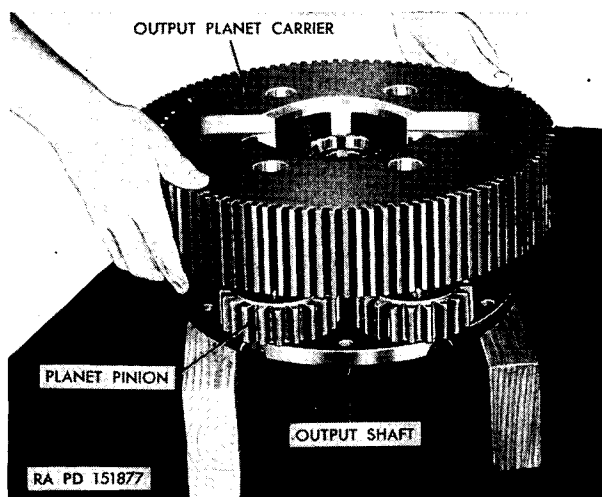


Figure 138. Removing output planet carrier.

inner-bearing race off the end cover hub and press a new one on.

- (3) To replace the end-cover hub, place the hub in position and thread three long $\frac{3}{8}$ -inch bolts evenly around the outside of the end cover and into the end-cover hub. Then draw the hub up evenly, being careful of the "O" ring gasket. Remove the three long bolts. Install the eight $\frac{3}{8}$ -inch bolts. Torque the bolts 26 to 32 pound-feet.

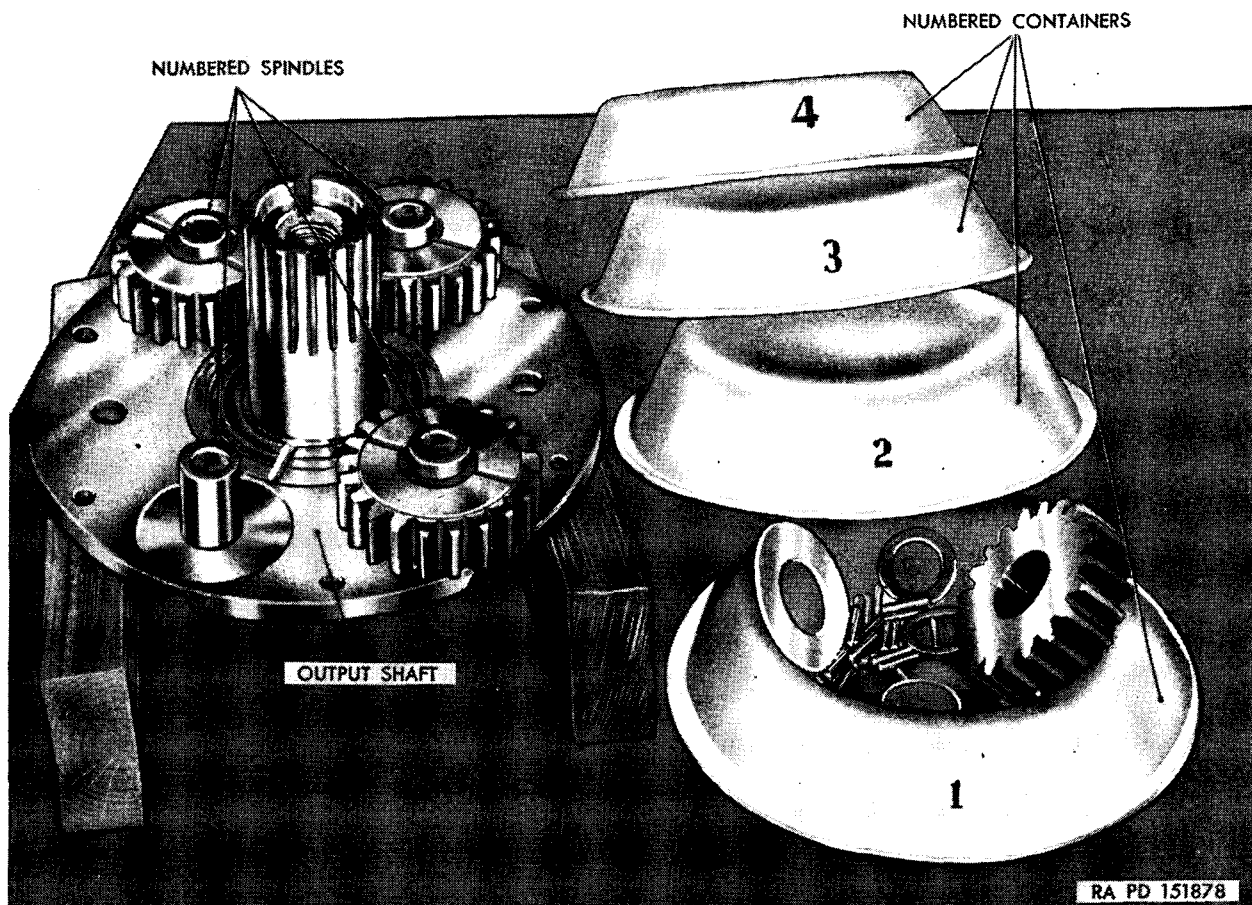


Figure 139. Planet pinion assembly in proper container.

- (4) The output-flange spring-loaded lip-type oil seal should never be removed from the hub unless it is defective. To remove the seal, drive it out with a drift. Install a new seal using replacer (41-R-2398-950) and handle (41-H-1396-510) (fig. 141).
 - (5) Do not remove the two bushings from the hub unless defective. If it is necessary to remove them, the output-shaft bushing can be pressed out but the output-flange bushing must be cut out. Replace the output-flange bushing with replacer (41-R-2387-750) and handle (41-H-1396-510) (fig. 142) and replace the output-shaft bushing by pressing it in. Then the bushings must be bored to size.
- c. BRAKE APPLY SHAFT OIL SEAL.
- (1) If the brake-apply-shaft oil seal is defective, drive it out with a drift from the inside of the end cover.
 - (2) Press in a new oil seal, using the old oil seal as an aid.
- d. STEERING OUTPUT PINION BEARING.
- (1) Do not remove the roller bearing from the steering-output pinion unless it is defective.
 - (2) If defective, press off the old bearing and press on a new one, using an arbor press.
- e. OUTPUT SHAFT.
- (1) Do not remove the two snap rings, one seal ring, one bearing inner race, and four spindles from the output shaft unless they are defective (fig. 143).
 - (2) To remove a defective spindle, remove the lock screw from the outer edge of the output shaft. Press out the spindle from the inner side of the shaft. Press in a new spindle. Install and stake the lock screw.

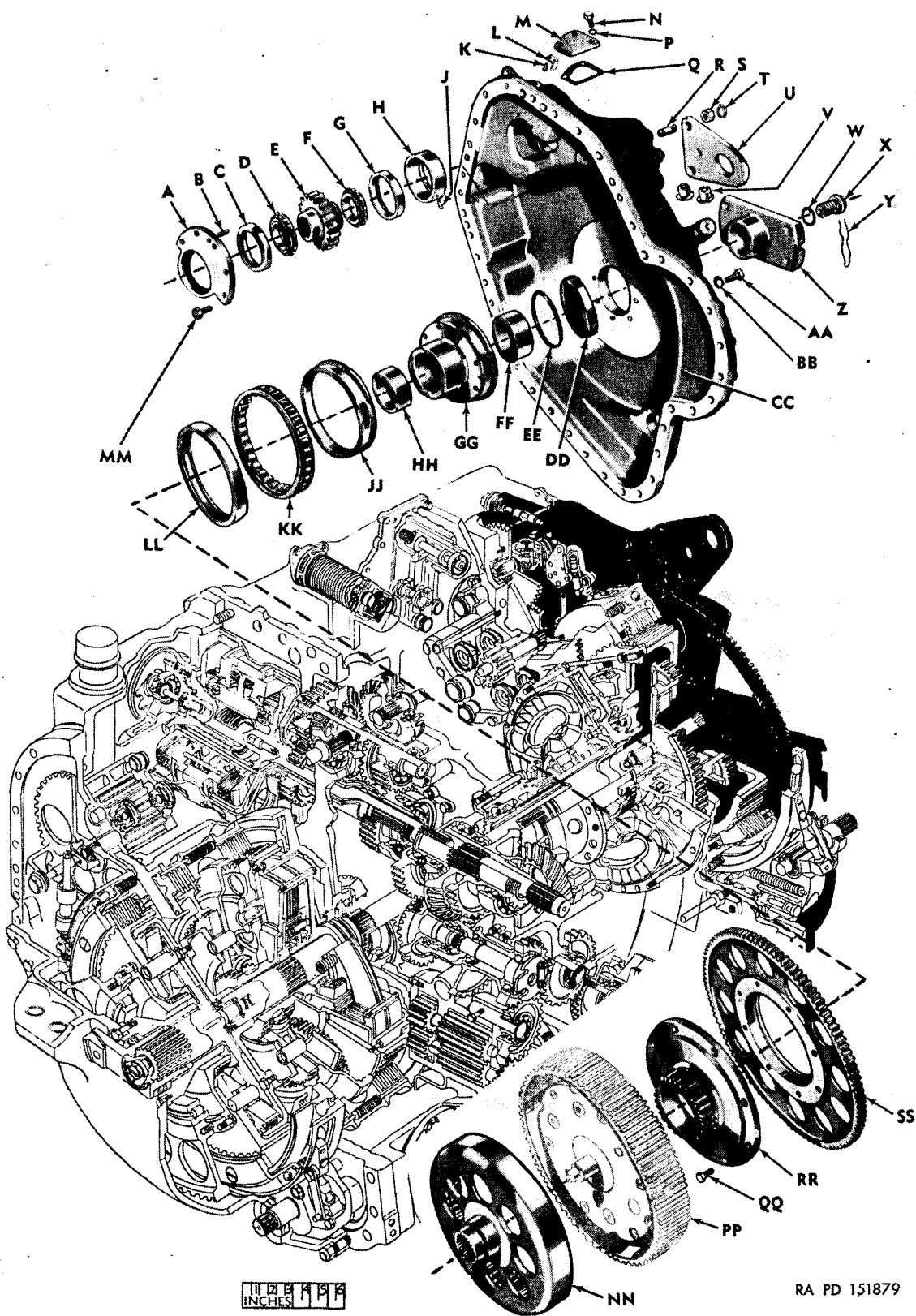


Figure 140. Left-end-cover assembly—exploded view.

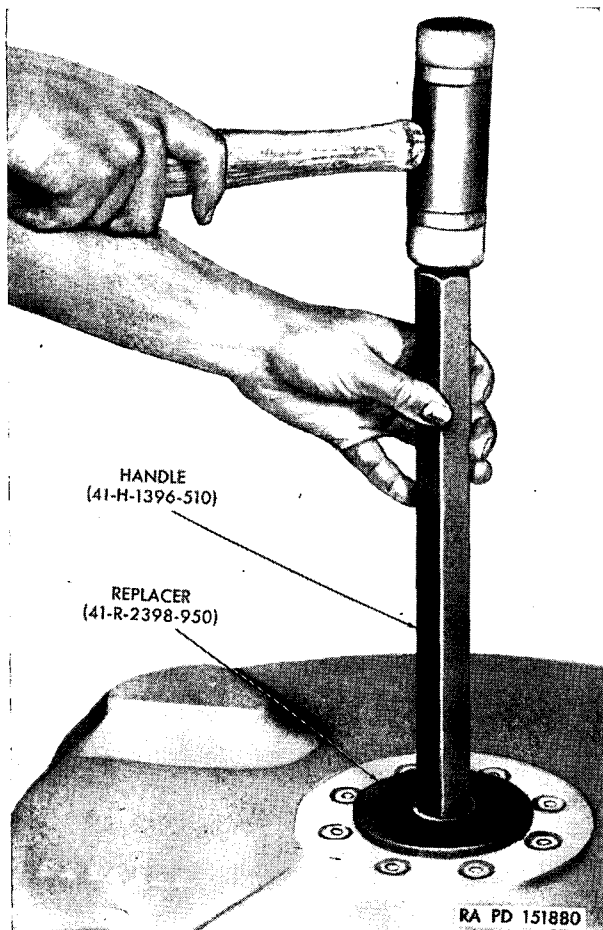


Figure 141. Replacing output-flange oil seal.

f. CONVERTER LOCK-UP GOVERNOR.

- (1) The lock-up governor (fig. 144) should be disassembled to check for any defective parts. Place the governor in a vise equipped with soft jaws. Using two screwdrivers, remove the rotor assembly from the lock-up governor cover (fig. 145).
- (2) Do not remove the bearing from the rotor unless it is defective. Replace the three hook-type seal rings if they are defective or worn. Remove the four bolts from the rotor assembly by turning down the tabs on the lock plate and then using a $\frac{1}{16}$ -inch wrench.
- (3) Remove the lock plate, cover plate, and gasket. Shake out the bushing retainer and remove the weight, bushing, and plunger from the rotor assembly (fig. 146).

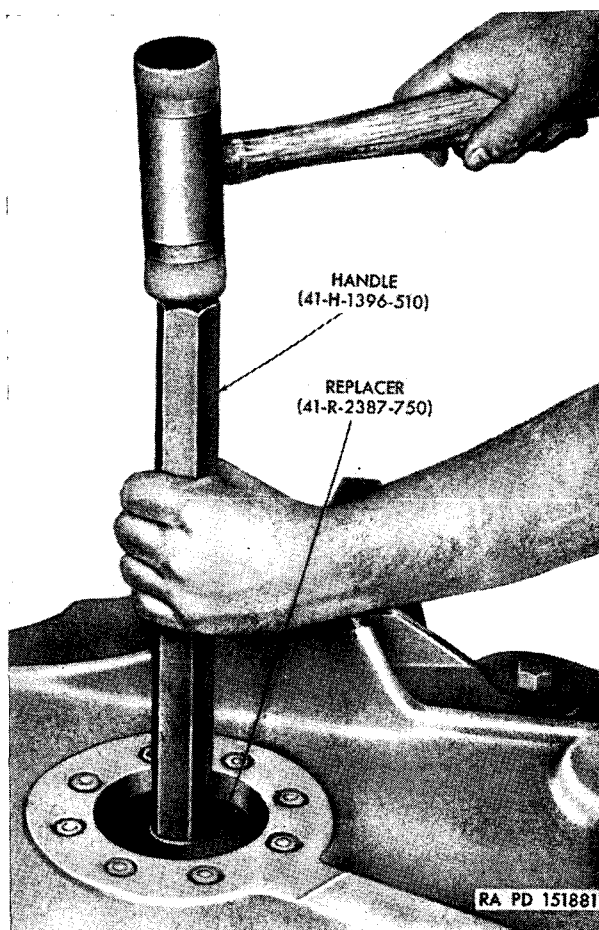


Figure 142. Replacing output-flange bushing.

- (4) If the weight, bushing, or plunger is defective, place the weight in a vise equipped with soft jaws and remove the plunger from the weight using a screwdriver. In rebuilding the assembly, place the plunger through the bushing into the weight with the retainer slot of the bushing next to the slotted end of the plunger. After it is threaded in tightly, lock the weight to the plunger by staking in two places.
- (5) If the sleeve in the governor cover is damaged, a new cover and sleeve assembly should be installed.
- (6) Insert the weight, bushing, and plunger assembly into the rotor body of the converter lock-up governor. Install the bushing retainer in the bushing retainer slot with the cutaway section away from the weight (fig. 147).

A—INNER BEARING CAGE GM-6704161
 B—PIN GM-110409
 C—OUTER RACE GM-7450040
 D—BEARING GM-7450040
 E—STEERING OUTPUT PINION GM-6704110
 F—BEARING GM-7450040
 G—OUTER RACE GM-7450040
 H—OUTER BEARING CAGE GM-6704145
 J—PIN GM-141221
 K—RIVET (2) GM-135267
 L—PLATE GM-6765474
 M—COVER GM-6765473
 N—BOLT (3) GM-221583
 P—WASHER (3) GM-103340
 Q—GASKET—GM-6763959
 R—STUD (3) GM-6764056
 S—NUT (3) GM-103028
 T—JAM NUT (3) GM-145493
 U—BRACKET GM-6764055
 V—BUSHING GM-6704442
 W—WASHER GM-8892925
 X—OUTPUT FLANGE RETAINER SCREW GM-6762008
 Y—LOCKING WIRE 22-W-1630
 Z—LEFT OUTPUT FLANGE ASSEMBLY GM-6764586
 AA—BOLT (8) GM-192094
 BB—WASHER (8) GM-103341
 CC—LEFT END COVER GM-6763887
 DD—OUTPUT FLANGE OIL SEAL GM-6704106
 EE—“O” RING GASKET GM-6760886
 FF—OUTPUT FLANGE BUSHING GM-6704107
 GG—END COVER HUB GM-6704104
 HH—OUTPUT SHAFT BUSHING GM-6704167
 JJ—INNER RACE GM-6761442
 KK—ROLLERS GM-6761442
 LL—OUTER RACE GM-6761442
 MM—BOLT (5) GM-192099
 NN—LEFT OUTPUT RING GEAR GM-6763766
 PP—OUTPUT PLANET CARRIER ASSEMBLY GM-6765353
 QQ—BOLT (8) GM-190768
 RR—OUTPUT SUN GEAR GM-6704118
 SS—STEERING OUTPUT GEAR GM-6764061

Figure 140—Continued.

- (7) Install the gasket, cover plate, and lock plate. Secure with four $\frac{1}{4}$ -inch bolts and lock by turning up the four corners of the lock plate.
- (8) Install the rotor assembly into the governor cover. Apply heavy grease to the hook-type seal rings to center them. Start the assembly in by hand, being careful of the three hook-type seal rings. Press it into position.

35. Assembly of Left End Cover

a. OUTPUT SHAFT.

- (1) Place the output shaft on wooden blocks with the shaft up and install the large thrust washer.
- (2) Taking parts from the No. 1 container (fig. 139), install the spacer and thrust washer on the No. 1 spindle.
- (3) Then install the planet pinion, 22 rollers, spacer, and thrust washer on the spindle. Assemble the other three sets of planet pinion assemblies using the same procedure.

b. OUTPUT PLANET CARRIER.

- (1) Install the planet carrier on the output shaft. Use a soft hammer to seat the carrier on the spindles.
- (2) Turn the assembly over and install six $\frac{5}{16}$ -inch bolts.
- (3) Torque the bolts 50 to 60 pound-feet. Install the thrust washer on the inner side of the assembly.

c. OUTPUT SUN GEAR AND STEERING OUTPUT GEAR.

- (1) Press the outer race and the roller bearing assembly into the steering output gear.
- (2) Then install the output sun gear on the steering output gear. Secure them with

eight $\frac{1}{2}$ -inch bolts (fig. 148). Torque the bolts 83 to 100 pound-feet.

d. END COVER, INNER SIDE.

- (1) Place the end cover on the assembly table with the split line up.
- (2) Check the two "O" ring gaskets on the split line and replace if defective.
- (3) Block up the end cover so that it is level.
- (4) Coat the roller bearings on the steering-output gear with heavy grease and push them back into place. Install the steering-output gear and output-sun gear assembly on the end cover hub (fig. 135).

e. STEERING OUTPUT PINION.

- (1) Install the steering-output-pinion outer bearing race into the outer cage in the end cover.
- (2) Install the steering-output-pinion and bearing assembly into the outer race (fig. 149).
- (3) Install the bearing outer race into the inner bearing cage.
- (4) Install the bearing outer-race and inner bearing cage assembly into the end cover, alining with the dowel pin. Secure it with five $\frac{5}{16}$ -inch bolts. Torque the bolts 17 to 20 pound-feet.

f. END COVER, OUTER SIDE.

- (1) Turn the end cover over and place it on its split line.
- (2) Install the converter lock-up governor assembly and gasket into the end cover (fig. 133). Secure it with five $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet.
- (3) Install the lock-up governor relay valve, retainer, spring, copper gasket, and plug, in the end cover. The long pilot on the valve should be next to the spring. Use a 1-inch wrench to tighten the plug (fig. 132).

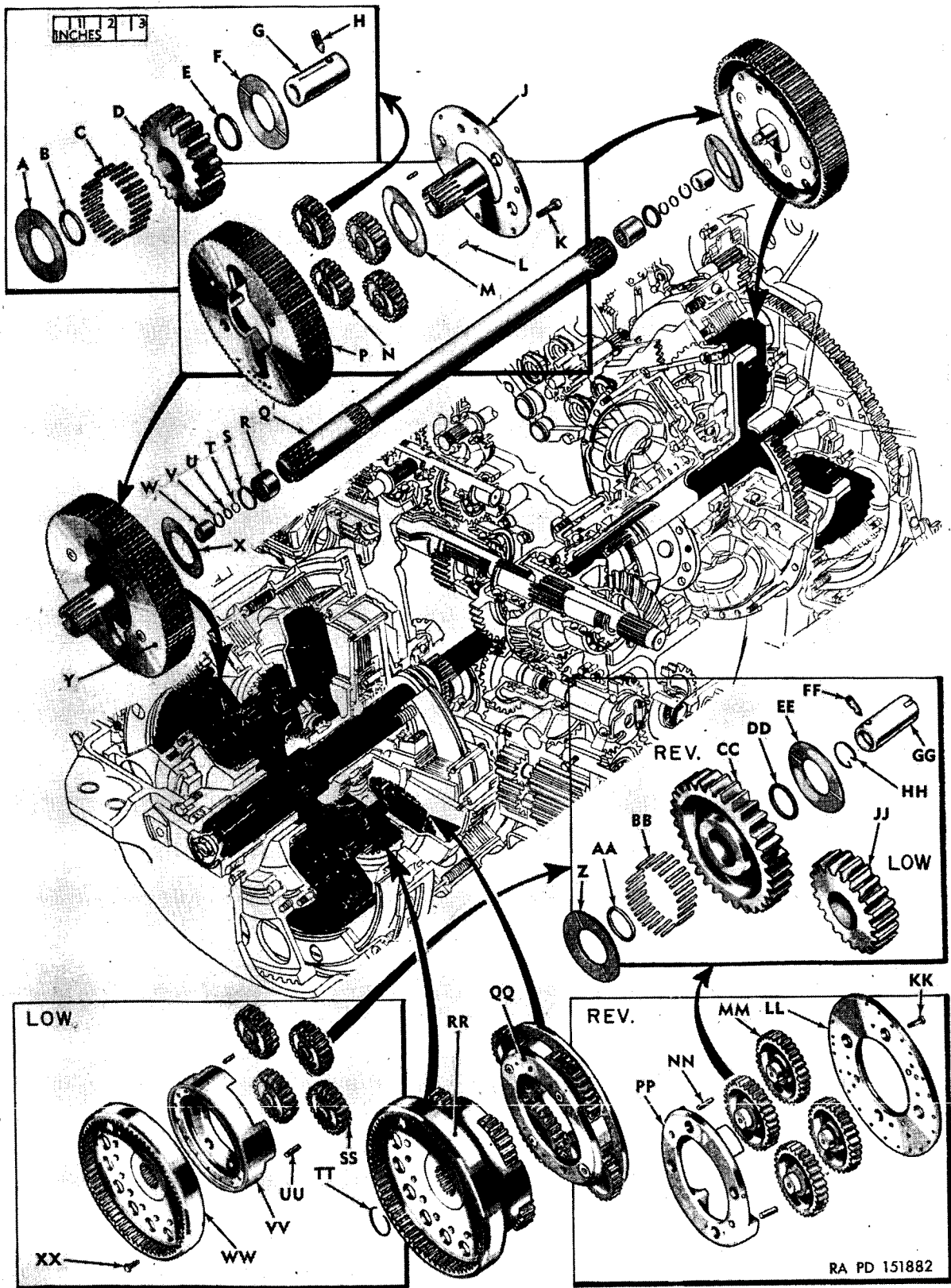
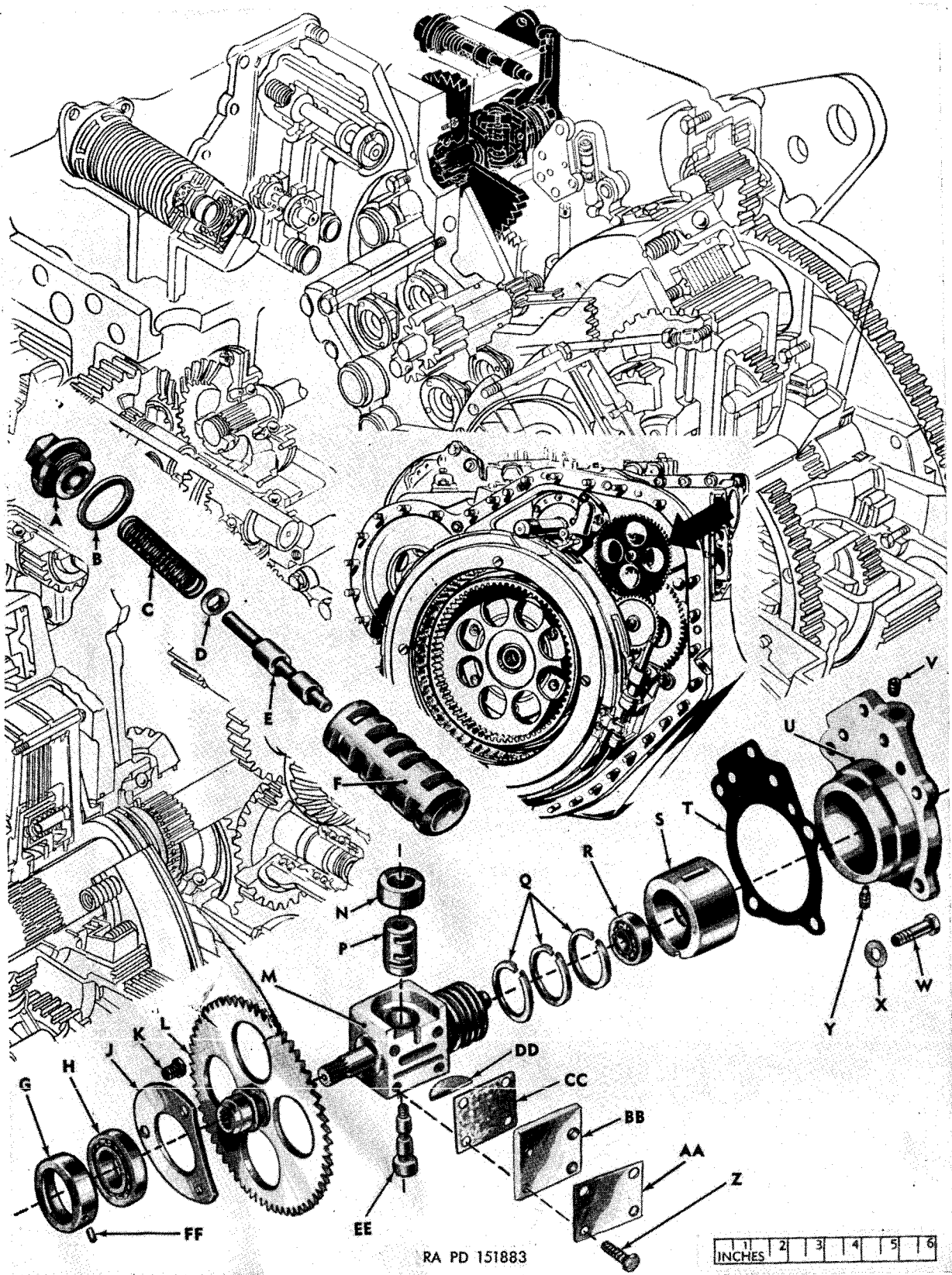


Figure 143. Planetary assemblies—exploded view.

A—THRUST WASHER GM-6704170
 B—SPACER GM-6704169
 C—BEARING (22) GM-6704426
 D—OUTPUT PLANET PINION GM-6704115
 E—SPACER GM-6704169
 F—THRUST WASHER GM-6704170
 G—SPINDLE ASSEMBLY GM-6763903
 H—LOCK SCREW GM-6703418
 J—OUTPUT SHAFT GM-6763966
 K—BOLT (6) GM-192101
 L—DOWEL (2) GM-6703313
 M—THRUST WASHER GM-6763987
 N—MATCHED SET OF FOUR PINIONS GM-6760160
 P—OUTPUT PLANET CARRIER (2) GM-6765338
 Q—CROSS DRIVE SHAFT GM-6763734
 R—NEEDLE BEARING (2) GM-6760161
 S—RETAINER (2) GM-6760635
 T—SNAP RING (2) GM-8892832
 U—RING (2) GM-8892873
 V—SNAP RING (2) GM-8892831
 W—RACE (2) GM-6761283
 X—THRUST WASHER (2) GM-6704111
 Y—OUTPUT PLANET CARRIER ASSEMBLY (2) GM-6765353
 Z—THRUST WASHER GM-6704428
 AA—SPACER GM-6704429
 BB—BEARING (22) GM-6704426
 CC—REVERSE-RANGE PLANET PINION GM-6763702
 DD—SPACER GM-6704429
 EE—THRUST WASHER GM-6704428
 FF—PIN GM-6702379
 GG—LOW- AND REVERSE-RANGE SPINDLE ASSEMBLY GM-6763910
 HH—SNAP RING GM-6704099
 JJ—LOW-RANGE PLANET PINION GM-6704431
 KK—BOLT (8) GM-192101
 LL—PLATE GM-6763710
 MM—MATCHED SET OF FOUR PINIONS GM-6763720
 NN—DOWEL (2) GM-6703313
 PP—REVERSE-RANGE PLANET CARRIER GM-6760057
 QQ—REVERSE-RANGE PLANET CARRIER ASSEMBLY GM-6764579
 RR—LOW-RANGE PLANET CARRIER ASSEMBLY GM-6765281
 SS—MATCHED SET OF FOUR PINIONS GM-6760417
 TT—SNAP RING GM-6763440
 UU—DOWEL (2) GM-6703313
 VV—LOW RANGE PLANET CARRIER GM-6765279
 WW—RIGHT OUTPUT RING GEAR GM-6765278
 XX—BOLT (16) GM-6764129

Figure 143—Continued.



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Figure 144. Governor assembly—exploded view.

A—RELAY VALVE PLUG GM-6763925
 B—COPPER GASKET GM-6760128
 C—SPRING GM-6763927
 D—RETAINER GM-6763928
 E—LOCK-UP GOVERNOR RELAY VALVE GM-6763938
 F—SLEEVE GM-6763939
 G—CAGE GM-6763890
 H—BEARING GM-903005
 J—RETAINER GM-6763891
 K—BOLT GM-191590
 L—GOVERNOR DRIVEN GEAR GM-6764887
 M—CONVERTER LOCK-UP GOVERNOR ROTOR GM-6763886
 N—WEIGHT GM-6763935
 P—BUSHING GM-8609439
 Q—HOOK-TYPE SEAL RING GM-6763299
 R—BEARING GM-903200
 S—INSERT GM-6763908
 T—GASKET GM-6763916
 U—LOCK-UP GOVERNOR COVER GM-6763902
 V—PIPE PLUG (2) GM-444689
 W—BOLT (5) GM-221583
 X—WASHER (5) GM-103340
 Y—SETSCREW GM-139705
 Z—BOLT (4) GM-446565
 AA—LOCK PLATE GM-6703346
 BB—COVER PLATE GM-6701758
 CC—GASKET GM-6701757
 DD—BUSHING RETAINER GM-6701756
 EE—PLUNGER GM-8609378
 FF—PIN GM-103688

Figure 144—Continued.

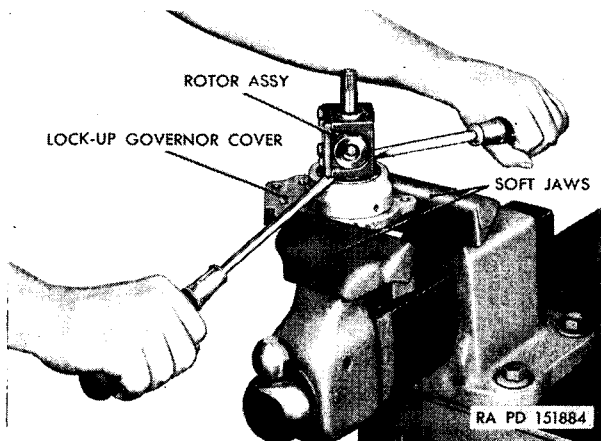


Figure 145. Removing governor rotor assembly.

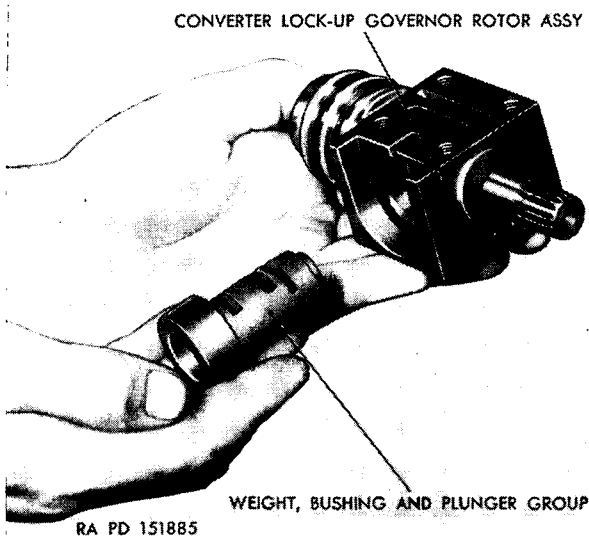


Figure 146. Removing or installing governor weight, bushing, and plunger.

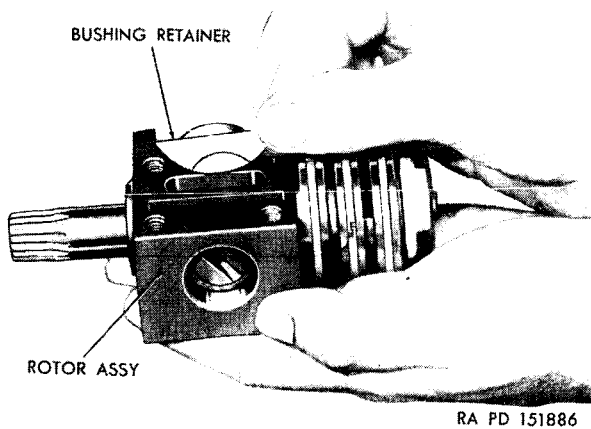


Figure 147. Installing governor retainer.

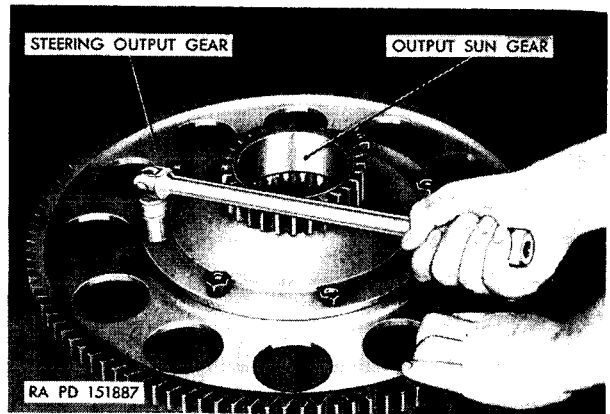


Figure 148. Installing output sun gear.

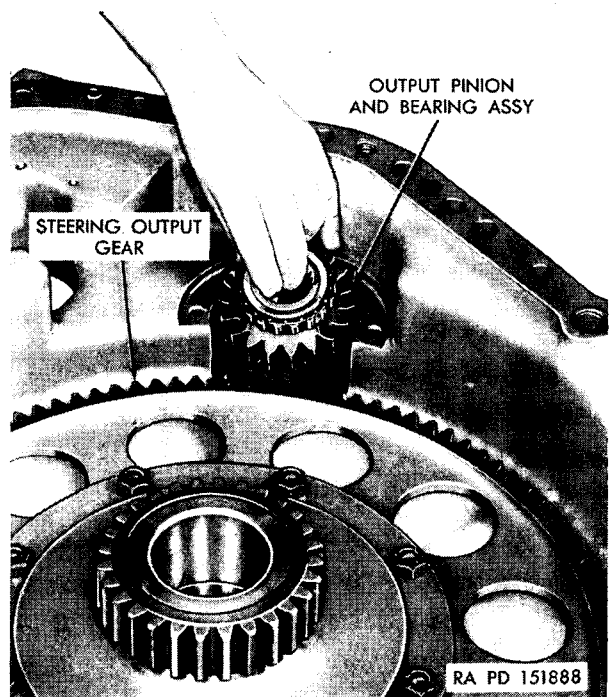


Figure 149. Installing steering-output-pinion and bearing assembly.

Section VI. REBUILD OF LEFT END PLATE

36. Disassembly of Left End Plate

a. Lay the end plate assembly, brake side up, on the assembly table. Install retainer (C7083772) to prevent spilling the 229 ball bearings located between these two parts. Using a $\frac{1}{2}$ -inch wrench, remove three bolts from the brake-signal valve and remove it from the end plate (fig. 150).

b. Disassemble the left brake.

Note. The left brake is to be disassembled in the same way as the right brake was disassembled. Refer to paragraph 23i for the disassembly of the right brake.

c. Using a $\frac{5}{8}$ -inch wrench, remove the self-locking nut that secures the output-brake and pressure-pump shaft to the pump and governor drive gear. Lift the governor drive gear from the splined pump-drive shaft (fig. 151). Using a $\frac{1}{2}$ -inch wrench, remove the three bolts from the governor-driven-gear bearing retainer. Using a screwdriver and a small block of wood, pry the governor-driven gear and bearing assembly out of the cage in the end plate (fig. 152).

Caution: Use the utmost care, when prying with the screwdriver, to prevent damaging the parts. Pry the pump-drive gear off the pump drive shaft. Turn the end plate assembly over and place it on wooden blocks. Using a $\frac{1}{2}$ -inch wrench, remove the nine bolts that secure the output-

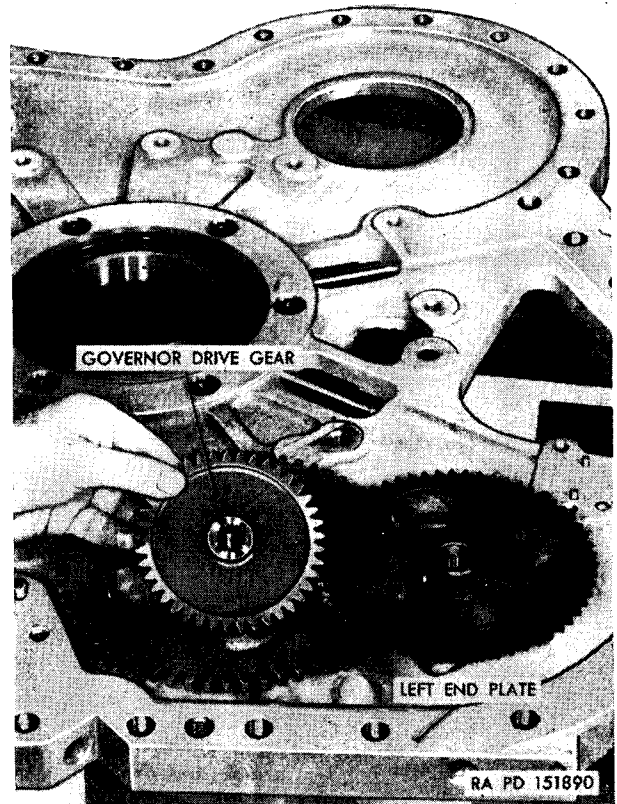


Figure 151. Removing or installing governor drive gear.

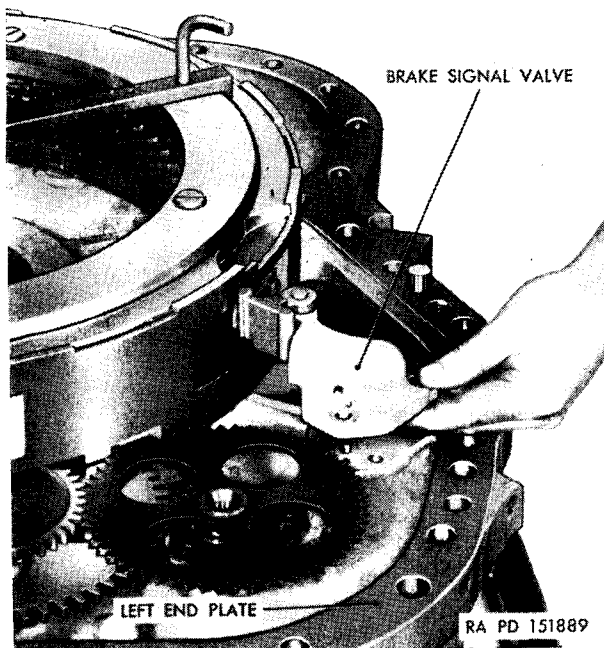


Figure 150. Removing or installing brake signal valve.

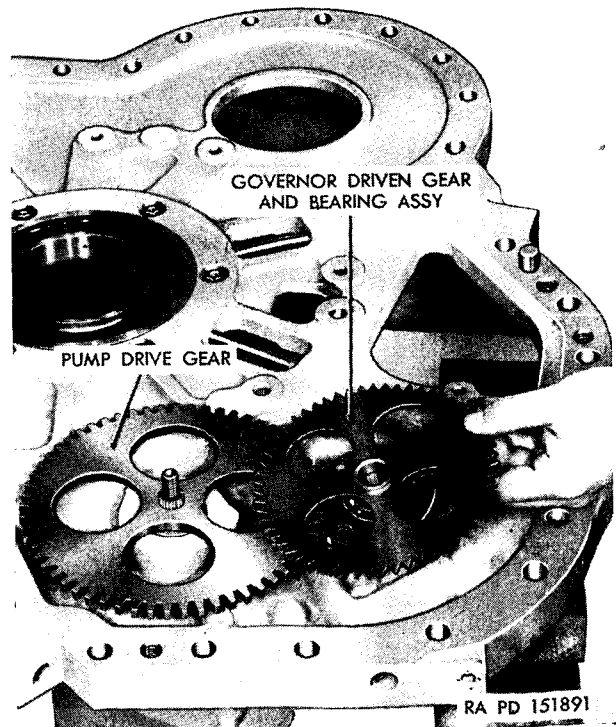
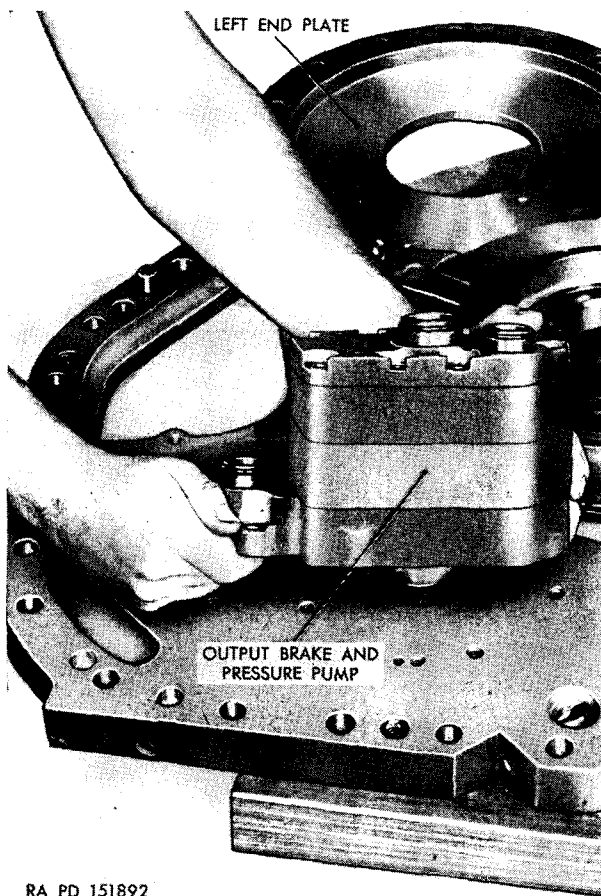


Figure 152. Removing or installing governor driven gear and bearing assembly.



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Figure 153. Removing or installing output-brake and pressure pump.

brake and pressure pump to the end plate. Using a soft hammer, gently tap the pump off the dowel pins. Remove the pump from the end plate (fig. 153).

37. Cleaning

Refer to paragraph 25 for cleaning instructions.

38. Inspection and Repair

a. GENERAL. Refer to paragraph 26*a* through *l* for general inspection and repair procedure. Refer to paragraph 97 for serviceability measurements and wear limits.

b. END PLATE.

- (1) Inspect the end plate. Inspect the fan gear oil tubes and fittings on the end plate for damage (fig. 154). If it is necessary to remove the tubes, use a small punch or chisel to bend back the corners of the clips retaining the lower

oil tube. Using a $\frac{1}{16}$ -inch wrench, remove the two bolts that retain the lower oil tube. Using a $\frac{1}{16}$ -inch open-end wrench remove the nuts from the fitting at each end of the two tubes and remove the tubes (fig. 155). If the fittings are damaged or dirty remove them. To assemble, install the fittings if they have been removed. Install the tubes on the fittings. Install the two bolts through the clips on the lower oil tube and into the end plate. While holding the tubes in their correct position, tighten the nuts on the ends of the tubes. Tighten the two bolts to secure the lower oil tube.

- (2) Inspect the converter lock-up clutch bearing retainer (fig. 154). If it is defective, use a $\frac{1}{2}$ -inch wrench to remove the six bolts and washers that secure it to the end plate. Use a soft hammer to remove the retainer. Remove the "O" ring gasket if it is defective. To assemble, install the "O" ring gasket on the retainer. Install the retainer in the end plate. Seat the retainer in the end plate using a soft hammer.

c. BRAKE SIGNAL VALVE.

- (1) Pull the brake-signal valve out of the brake-signal-valve body (fig. 157). Inspect the valve, valve sleeve, and valve body. Do not remove the sleeve from the valve body. If either the body or the sleeve is defective, replace the two parts as an assembly.
- (2) Inspect the arm on the valve body and make sure that it is free on the clevis pin. If the arm does not move easily, remove the cotter pin from the end of the clevis pin. Tap the clevis pin out of the valve body. Smooth the clevis pin using crocus cloth. To assemble, install the clevis pin with its drilled end toward the valve body base.

d. BRAKE ANCHOR ASSEMBLY. Inspect the brake anchor assembly (fig. 154). If the brake fixed-pressure plate must be removed from the brake anchor, remove two slotted head screws from the plate and tap it off the two dowels. When the plate is installed in the brake anchor, secure the screws by staking them.

e. BRAKE-APPLY RING AND CAM RING ASSEMBLIES.

- (1) Remove the retainer (C7083772) from the brake-apply-ring and cam ring assemblies (fig. 154).

Note. Lay the assembly flat on a table before removing the retainer.

- (2) Remove the brake-apply-cam-stationary ring from the assembly (fig. 158).
- (3) Remove the 12 steel balls from the ramps in the brake-apply-cam-rotating ring. Inspect the balls and the two cam rings. If the ramps are hollowed out from wear, replace the ring. The brake-apply ring and the cam-rotating ring need not be separated unless the cam ring is defective or unless the cam ring does not rotate smoothly.
- (4) If the cam-rotating ring must be removed, turn the assembly over and carefully lift off the brake-apply ring (fig. 159), so that none of the 229 steel balls will be lost.
- (5) Inspect the floating-pressure plate in the brake-apply ring. To remove the pressure plate, use a screwdriver to remove the four shoulder bolts.
- (6) To assemble, install the pressure plate in the brake-apply ring. Install and tighten the four shoulder bolts. Stake the bolts to the brake-apply ring.
- (7) Place the cam-rotating ring, ramp side down, on the assembly table. Place the brake-apply ring flange side up, and inside the cam-rotating ring.
- (8) Feed the 229 balls into the space between the cam-rotating ring and the brake apply ring (fig. 160). Lift up the cam-rotating ring and balls until the balls are against the flange of the brake-apply ring. Grasp the two rings firmly and turn them over so the flange of the brake-apply ring rests on the table.
- (9) Install a large steel ball in each of the 21 ramps on the cam rotating ring. Install the cam-stationary ring on the 12 balls (fig. 158). Install the retainer (C7083772).

f. BRAKE ADJUSTING BRACKET. Inspect the brake-adjusting bracket assembly for rough action and other defects (fig. 156). If it is necessary to disassemble the assembly, remove the snap ring that retains the brake-adjusting screw (fig. 161). Turn the screw out of the follower. Pull the screw, washer, and collar out of the bracket.

Replace any defective parts. To assemble, install the screw and collar in the bracket and turn the screw into the follower. Install the washer over the screw and install the snap ring (fig. 161).

g. BRAKE-SHAFT BRACKET ASSEMBLY.

- (1) Inspect the brake-shaft inner bracket (fig. 162). If the needle bearing is defective cut it out of the bracket, being careful not to damage the bracket. Install a new needle bearing using replacer (41-R-2379-960) and handle (41-H-1396-505) (fig. 163).
- (2) Inspect the brake-shaft bracket assembly. If it is necessary to disassemble this assembly, remove the snap ring from the apply shaft using snap ring pliers (41-P-1992-27) (fig. 164). Remove the spacer and pull the brake-apply shaft from the bracket (fig. 165). Loosen the setscrew in the brake-apply lever and remove the dowel (fig. 166). Remove the brake-apply lever from the bracket (fig. 167).
- (3) Inspect the brake-shaft bracket needle bearing. Drive or cut out the bearing if it is defective. Install a new bearing using replacer (41-R-2381-320) and handle (A7083701) (fig. 168).
- (4) To assemble, install the brake-apply lever in the bracket (fig. 167). Insert the dowel in the lever and insert the setscrew (fig. 166). Install the brake-apply shaft through the bracket and lever (fig. 165). Install the spacer on the end of the shaft. Install the snap ring on the shaft (fig. 164).

h. CAM-RETURN SPRING, CAM BRACKET AND LINKAGE. Inspect the cam-return spring, guide, and pilot. Inspect the brake-return-cam bracket. Inspect the brake-apply cam bracket. Inspect the brake-cooling-oil valve and linkage. Replace any defective parts.

Note. If a ball joint is loose, it is necessary that a new adjustment of the linkage be made when the valve and linkage are installed on the end plate.

To adjust the linkage the brakes must be in release position. Then aline the mark on the valve with the face of the brake-shaft inner bracket. Re-crimp the loose ball joint to the stud.

i. GOVERNOR DRIVE GEARS. Inspect the governor-driven gear and bearing assembly and the governor-drive gear. If it is necessary to remove the driven gear, press it out of the bearing. To assemble, place the retainer over the gear hub.

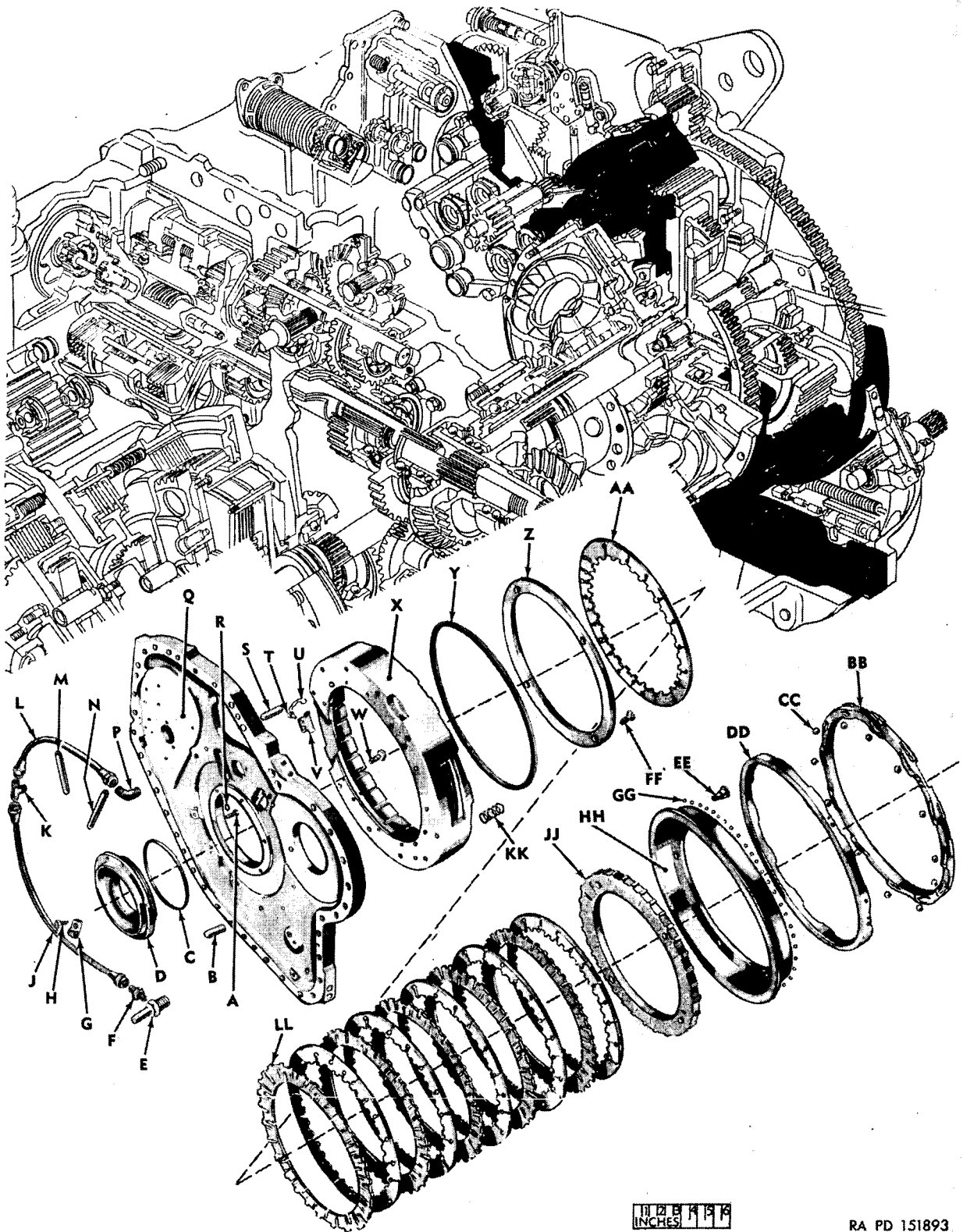


Figure 154. Left end plate, brake anchor, and brake disk assemblies—exploded view.

A—BOLT (6) GM-221584
 B—DOWEL (2) GM-6704448
 C—"O" RING GASKET GM-6750155
 D—CONVERTER LOCK-UP CLUTCH BEARING RETAINER GM-6763879
 E—NOZZLE GM-6760408
 F—NIPPLE GM-118748
 G—CLIP (2) GM-140578
 H—BOLT (2) GM-181354
 J—FAN GEAR LOWER OIL TUBE GM-6763980
 K—TEE GM-118758
 L—FAN GEAR UPPER OIL TUBE GM-6763979
 M—OIL TRANSFER TUBE GM-6763975
 N—OIL TRANSFER TUBE GM-6763975
 P—ELBOW GM-118753
 Q—LEFT END PLATE GM-6763896
 R—WASHER (6) GM-103340
 S—DOWEL GM-6704448
 T—SCREW (2) GM-6765471
 U—SAFETY WIRE GM-6704501
 V—INDICATOR GM-6765479
 W—BOLT (11) GM-192226
 X—LEFT ANCHOR ASSEMBLY GM-6763762
 Y—SEAL RING GM-6765032
 Z—BRAKE FIXED PRESSURE PLATE GM-6704125
 AA—INTERNAL SPLINED DISK (6) GM-6765641
 BB—BRAKE APPLY CAM STATIONARY RING GM-6764067
 CC—BALL (12) GM-145660
 DD—BRAKE APPLY CAM ROTATING RING GM-6764069
 EE—BOLT (4) GM-6764803
 FF—SCREW (2) GM-177945
 GG—BALL (229) GM-145639
 HH—BRAKE APPLY RING GM-6764004
 JJ—FLOATING PRESSURE PLATE GM-6763956
 KK—BRAKE PLATE RELEASE SPRING (10) GM-8894407
 LL—EXTERNAL SPLINED DISK (5) GM-6763906

Figure 154—Continued.

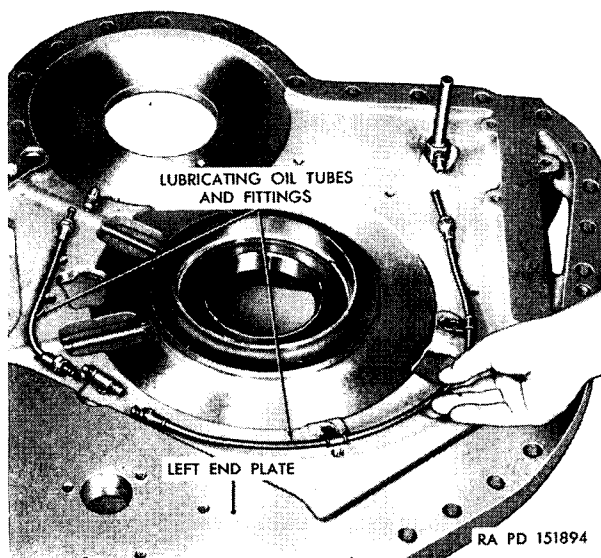


Figure 155. Removing brake oil tubes.

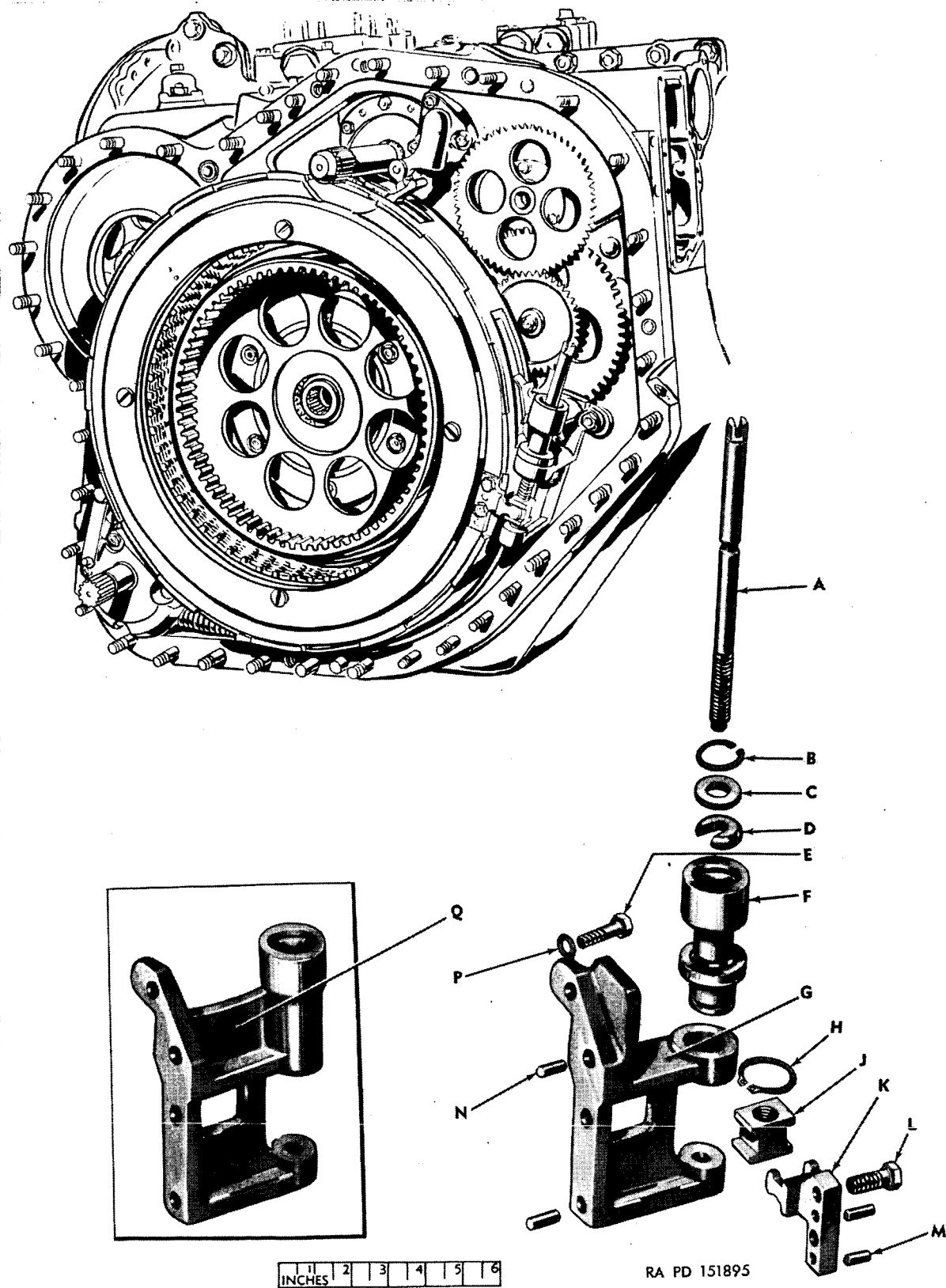


Figure 156. Left-brake adjusting bracket assembly—exploded view.

A—BRAKE ADJUSTING SCREW GM-6765470
B—SNAP RING GM-6703423
C—WASHER GM-6764864
D—COLLAR GM-6765478
E—BOLT (2) GM-192226
F—BRACKET ASSEMBLY GM-6765469
G—BRACKET ASSEMBLY GM-6765469
H—BRACKET ASSEMBLY GM-6765469
J—FOLLOWER GM-6764081
K—BRACKET GM-6764082
L—BOLT (2) GM-221583
M—DOWEL (2) GM-141196
N—DOWEL (2) GM-141240
P—WASHER (2) GM-103341
Q—ONE-PIECE BRACKET (REPLACES F, G, AND H) GM-6765469

Figure 156—Continued.

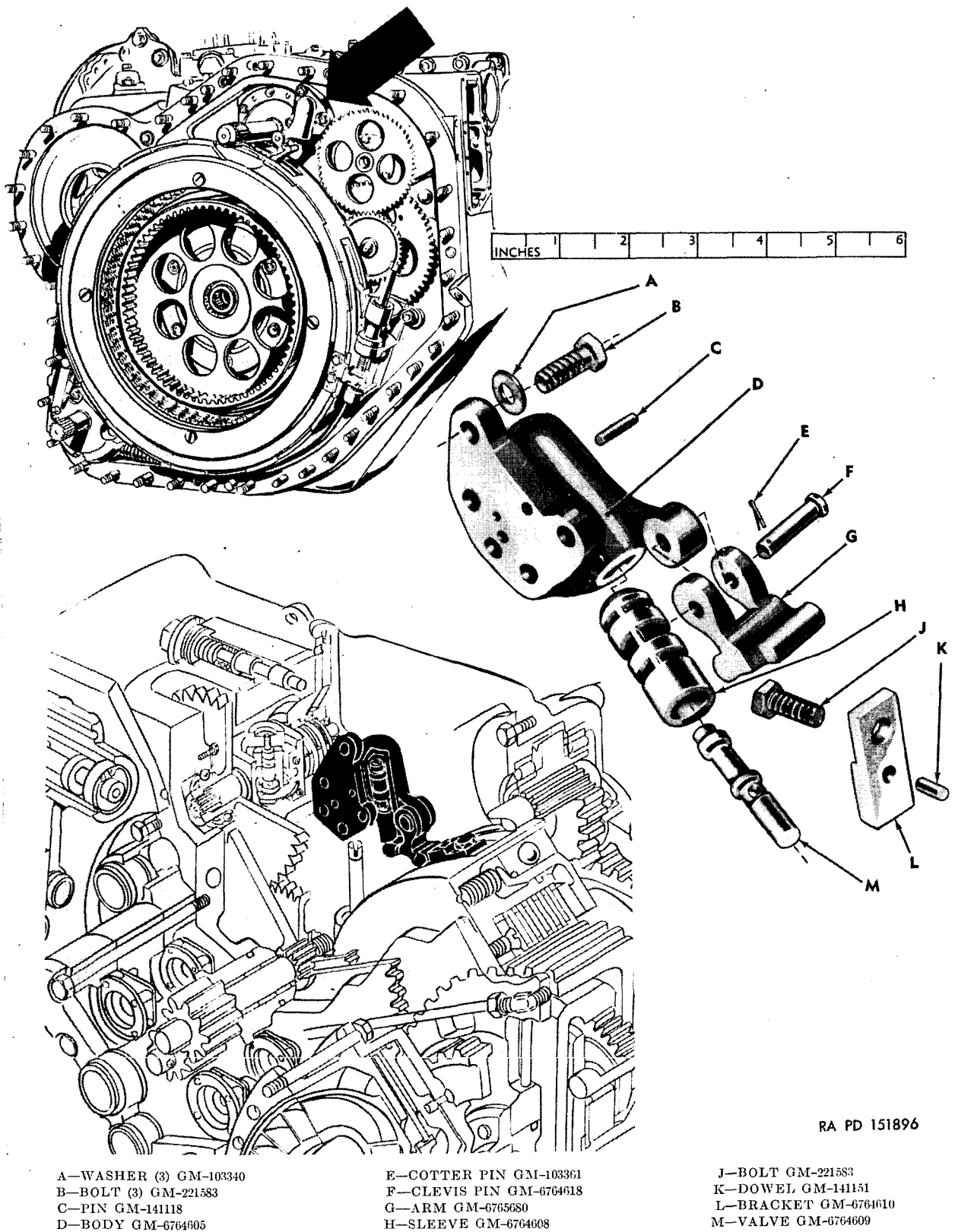
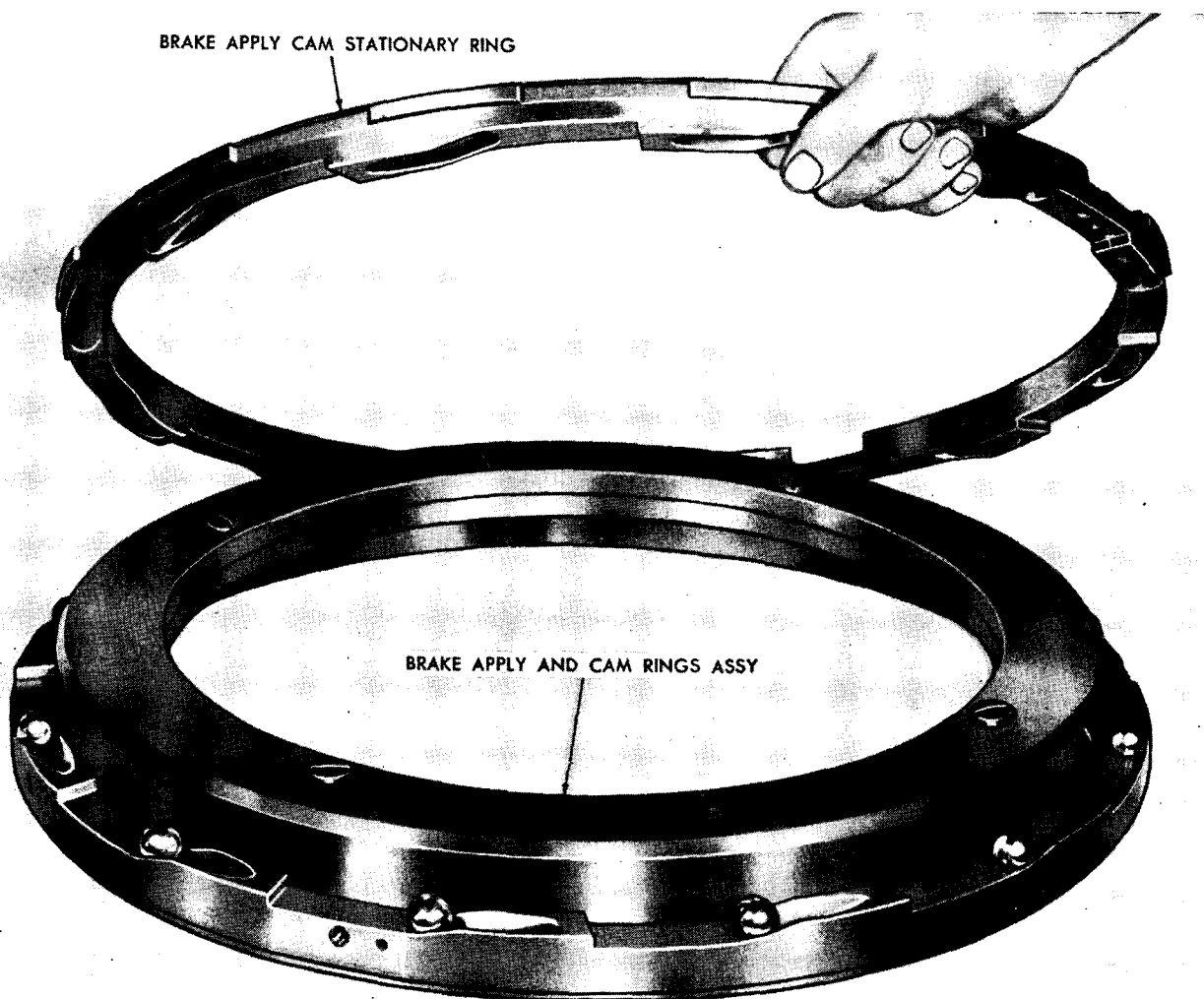


Figure 157. Brake-signal-valve assembly—exploded view.



RA PD 151897

Figure 158. Removing or installing brake-apply-cam stationary ring.

Install the bearing, lettered side away from the gear, using an arbor press.

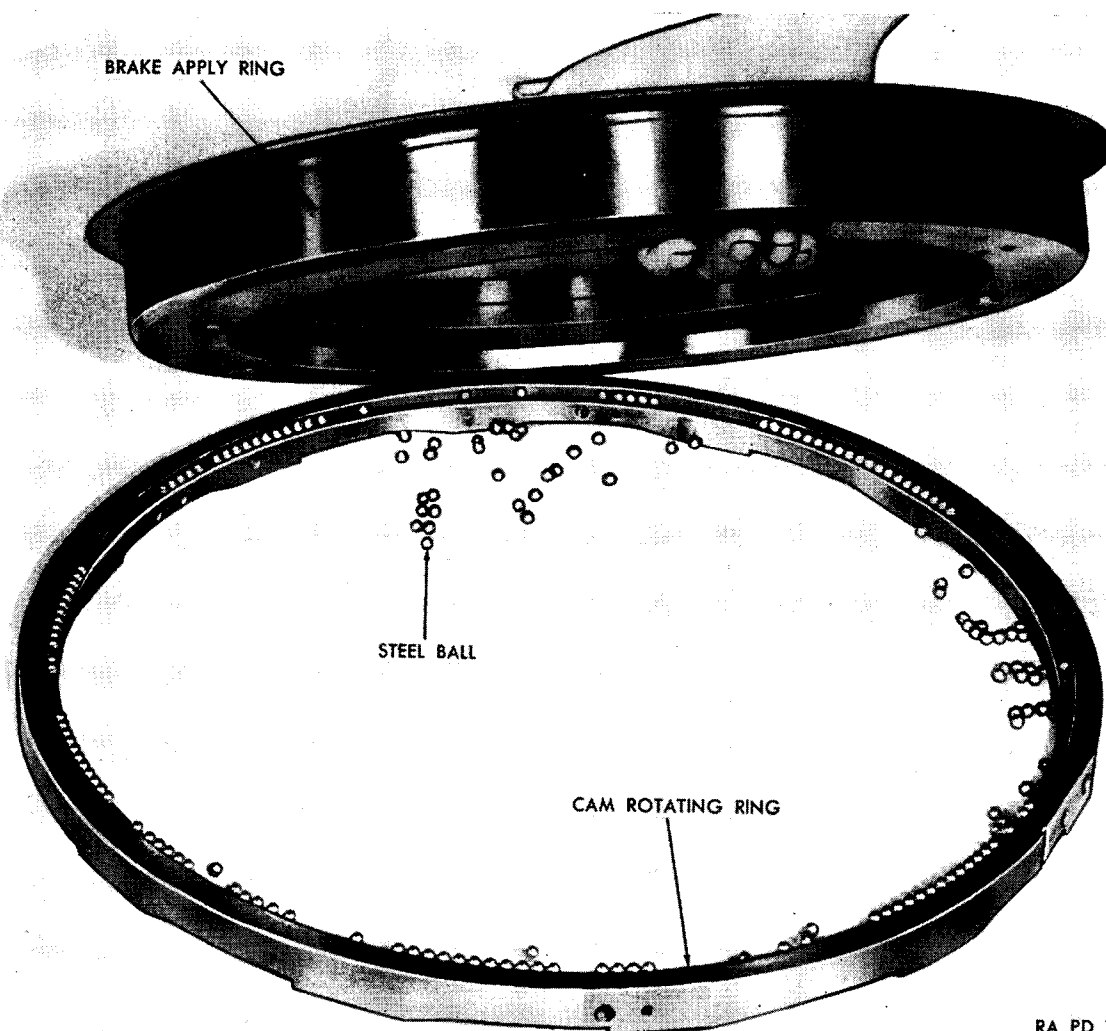
39. Assembly of Left End Plate

a. Install the output brake and pressure pump on the inside of the end plate (fig. 153). Secure the pump to the end plate with nine $\frac{5}{16}$ -inch bolts and washers. Turn the end plate over. Install the pump drive gear on the pump shaft with the pump drive gear shoulder next to the pump (fig. 169). Install the lock-up governor driven gear and bearing assembly into the cage in the end plate (fig. 152). Install three $\frac{5}{16}$ -inch bolts in the bearing retainer to secure it to the end plate.

Install the lock-up governor drive gear on the pump shaft, over the pump drive gear and with the flat side next to the pump drive gear (fig. 151). Secure the gears to the pump shaft with a $\frac{1}{16}$ -inch self-locking nut.

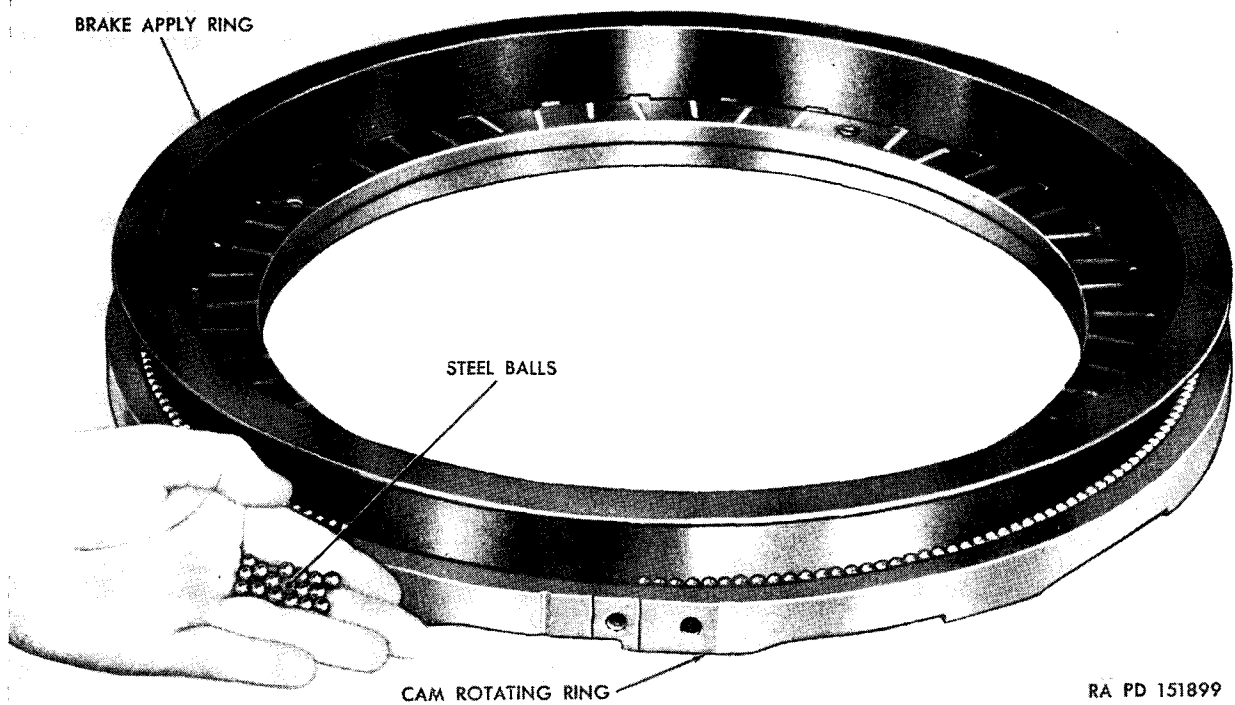
b. The assembly of the left brake is the same as the assembly of the right brake. Refer to paragraph 89c(5) through (10).

c. Install the brake signal valve in the valve body, with the closed end next to the apply arm. With the apply arm against the valve, install the valve assembly on the end plate (fig. 150). Secure the valve assembly to the end plate with three $\frac{5}{16}$ -inch bolts and washers.



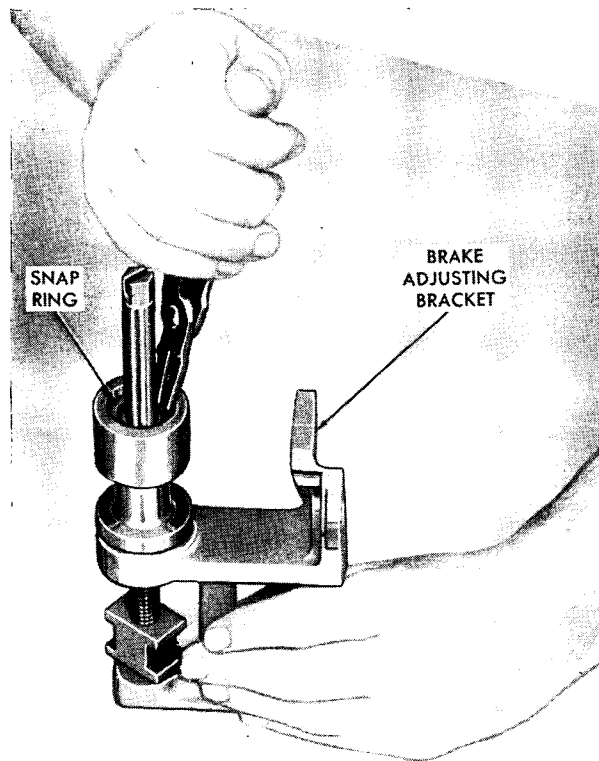
RA PD 151898

Figure 159. Removing brake apply ring.



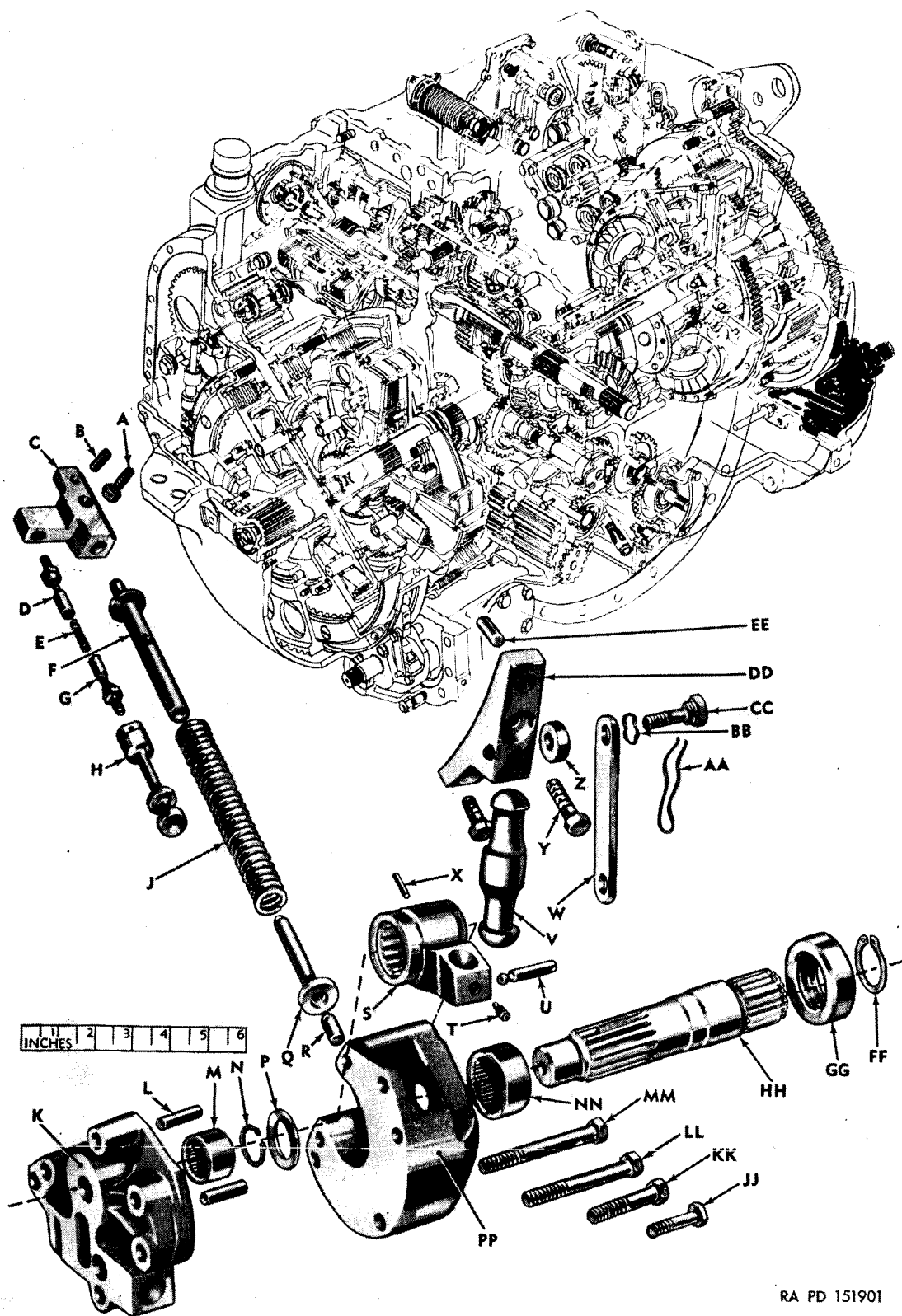
RA PD 151899

Figure 160. Placing small ball bearings on cam rotating ring.



RA PD 151900

Figure 161. Removing or installing brake-adjusting-screw snap ring.



RA PD 151901

Figure 162. Left brake apply mechanism—exploded view.

A—BOLT (2) GM-221583
 B—DOWEL GM-141151
 C—BRAKE RETURN CAM BRACKET GM-6763434
 D—BALL JOINT GM-6763193
 E—STUD GM-6762385
 F—CAM RETURN SPRING GUIDE GM-6763430
 G—BALL JOINT GM-6763193
 H—BRAKE COOLING OIL VALVE GM-6764566
 J—CAM RETURN SPRING GM-6703459
 K—BRAKE SHAFT INNER BRACKET GM-6764568
 L—DOWEL (2) GM-141247
 M—BRAKE-SHAFT-INNER-BRACKET NEEDLE BEARING GM-6702341
 N—SNAP RING GM-6762065
 P—SPACER GM-6762062
 Q—CAM RETURN SPRING PILOT GM-6702333
 R—CAM RETURN SPRING PIN GM-8894415
 S—BRAKE APPLY LEVER GM-6763448
 T—SET SCREW GM-223018
 U—DOWEL GM-6765038
 V—BRAKE APPLY STRUT GM-6764151
 W—STRUT RETAINER GM-6764691
 X—PIN GM-141148
 Y—BOLT (2) GM-221583
 Z—SPACER GM-6764885
 AA—LOCKING WIRE GM-6704501
 BB—WAVE WASHER GM-6764694
 CC—STRUT RETAINER BOLT GM-6764675
 DD—BRAKE APPLY CAM BRACKET GM-6704153
 EE—DOWEL GM-141242
 FF—SNAP RING GM-8892818
 GG—OIL SEAL GM-6700577
 HH—BRAKE APPLY SHAFT GM-6763469
 JJ—BOLT GM-192728
 KK—BOLT GM-221600
 LL—BOLT GM-433348
 MM—BOLT GM-186312
 NN—BRAKE-SHAFT-BRACKET NEEDLE BEARING GM-444916
 PP—BRAKE SHAFT BRACKET GM-6764588

Figure 162—Continued.

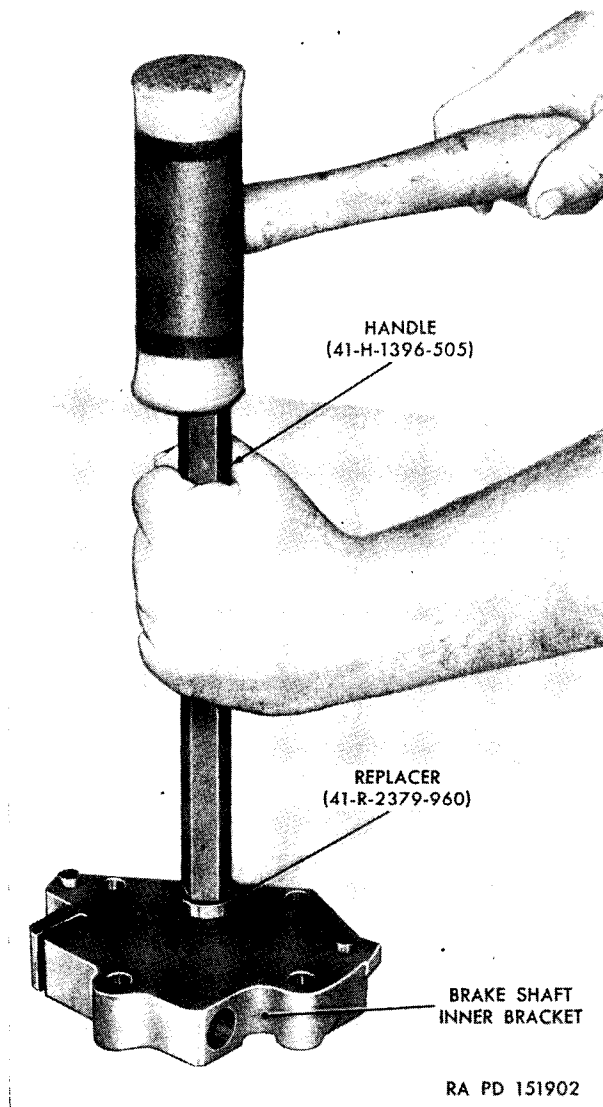


Figure 163. Installing brake-shaft-inner-bracket needle bearing.

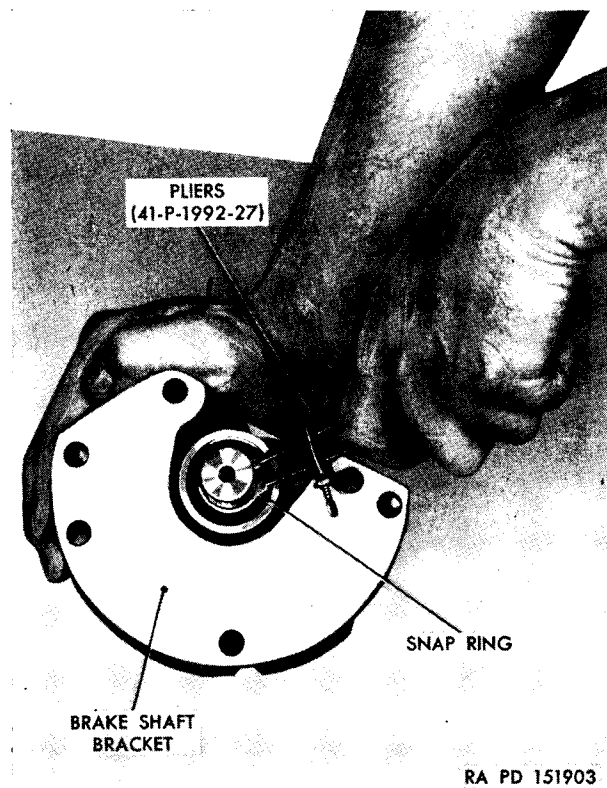


Figure 164. Removing or installing brake-apply-shaft snap ring.

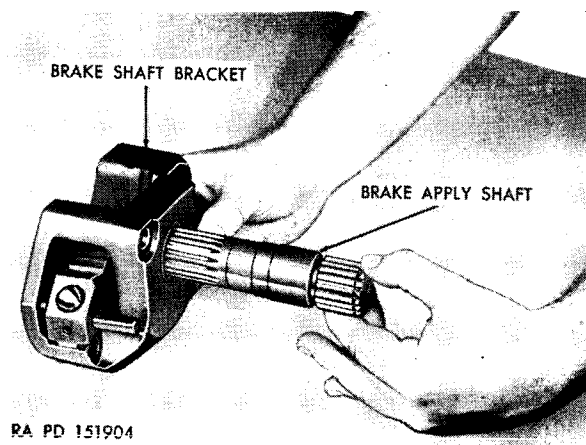


Figure 165. Removing or installing brake apply shaft.

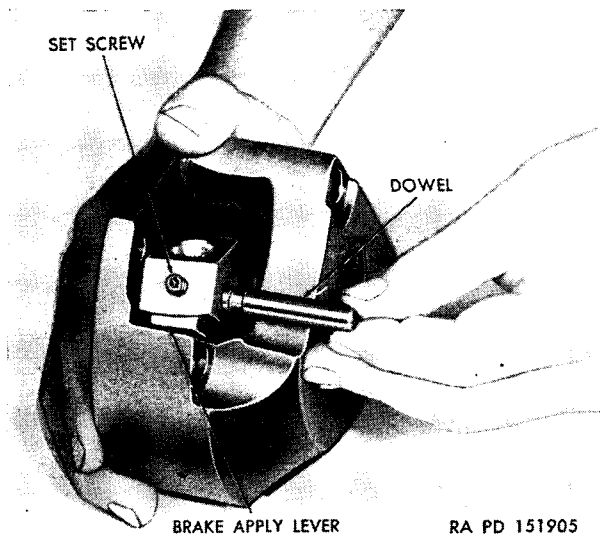


Figure 166. Removing or installing brake-apply-lever dowel.

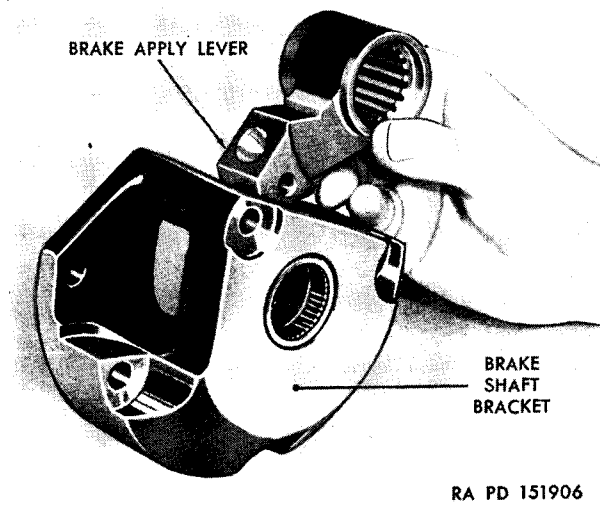


Figure 167. Removing or installing brake apply lever.

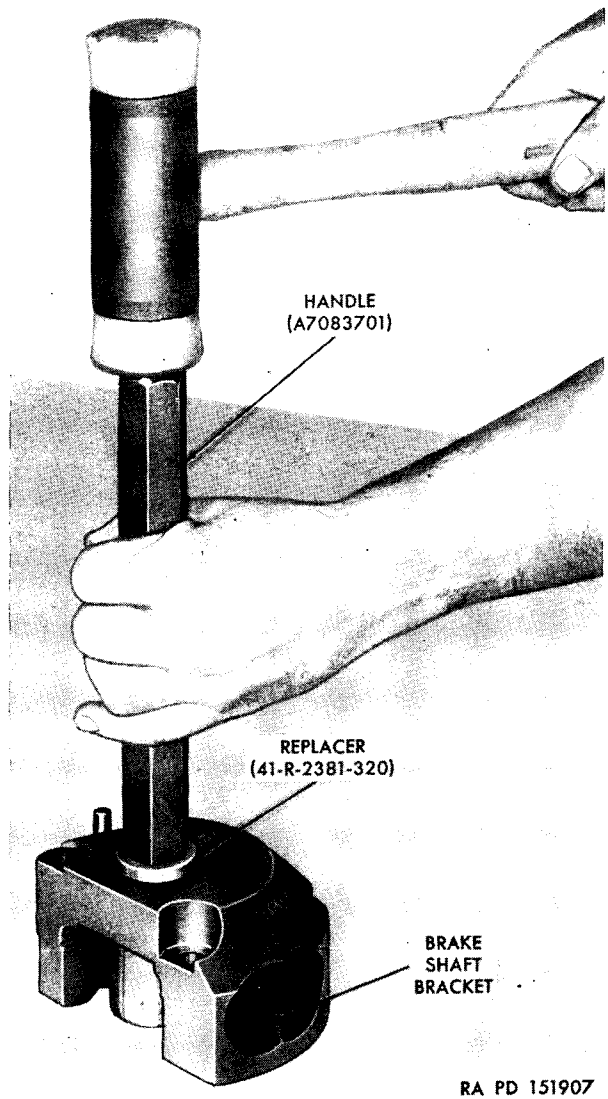


Figure 168. Installing brake-shaft-bracket-needle bearing.

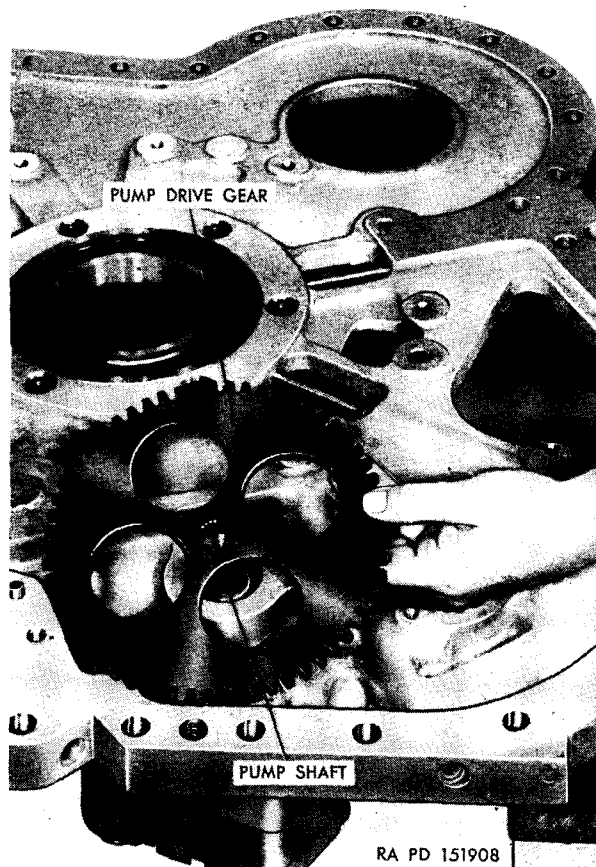


Figure 169. Installing brake and pressure-pump drive gear.

Section VII. REBUILD OF TORQUE CONVERTER

40. Disassembly of Torque Converter

a. STATORS.

- (1) Place the stator assemblies (fig. 170) on the assembly table with the pilot end of the arbor (41-A-339-24) resting on the table.

Note. At the time the staters were removed from the converter ground sleeve, they were put aside on the arbor.

Press the lower stator (second* stator) down on the pilot end of the arbor. Hold the first stator by the two stator hub spacers allowing the second stator to drop to the table (fig. 171).

Note. Pressing the stator off the pilot end of the arbor will prevent the loss of the springs and rollers when the tension of the springs is suddenly relieved.

- (2) Remove the thrust washer from between the staters and set the first stator and arbor (41-A-339-24) aside. Using a small screwdriver, carefully pry the stator-hub spacer from the second stator (fig. 172). Remove the 14 free-wheel springs and rollers. Remove the other stator-hub spacer. Using a small screwdriver, remove the stator-cam snap ring (fig. 173). Turn the stator over and press the stator cam out of the stator's splined center (fig. 174). Use a press if necessary, but be careful to avoid damaging the stator. It is unnecessary to remove the other stator-cam snap ring unless it is defective.

Note. Using the same precautions and instructions, the first stator can be disassembled if necessary.

b. PUMP.

- (1) Set the converter pump (fig. 175) on the assembly table with the internal face up. Remove the snap ring from the pump, using internal snap ring pliers (fig. 176).
- (2) Turn the pump over so that its internal face is down. Tap the converter pump hub out of the pump, using a soft hammer. Pry the ring from the converter pump hub, using a screwdriver. Check the "O" ring gasket and replace it if necessary.

c. LOCK-UP CLUTCH HOUSING.

- (1) Place the lock-up clutch housing on the assembly table with the lock-up clutch-main plate up. Remove the main plate by tapping it with a soft hammer (fig. 177). Do not remove the gasket unless it is defective. Remove the lock-up clutch plate (fig. 178). Remove the thrust washer. Remove the lock-up clutch piston (fig. 179).
- (2) Check the "O" ring seal on the piston and the one on the housing hub. Replace them if necessary. Turn the housing over. Remove eight bolts, using a ½-inch wrench, from the converter pump drive gear and remove the gear (fig. 180).

41. Cleaning

Refer to paragraph 25 for cleaning instructions.

42. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for general inspection and repair procedure. Refer to paragraph 98 for serviceability measurements and wear limits.

b. LOCK-UP CLUTCH HOUSING. Do not remove the bearing unless it is defective. If defective, pry it off and press on a new bearing. Remove the hook-type seal rings to see if they are worn. Replace them, if necessary. If the bushing is defective, it must be cut out and the pin must be removed. Press a new one in place, pin it, and bore the bushing to size.

c. TURBINE. The three hook-type seal rings on the converter turbine should be removed and checked for excessive wear. If they are worn, replace them. Check to see if the converter spacer is in place in the groove on the splined end of the converter shaft. This is the spacer which determines the amount of converter-turbine end play.

d. VANES. Inspect the turbine and pump vanes for dents, nicks, or burs which would cause turbulence in the flow of oil. Remove nicks and burs by careful filing and polishing. Remove dents by filing or if too worn replace the part. Remove any obstructions in the blade passages.

e. STATORS. Inspect the roller-retaining slots on each stator cam for wear, pits, and scores. If defective, replace the stator cam. Inspect the stator vanes for dents, nicks, or burs. Remove them by careful filing and polishing. If dents cannot be removed with a file, replace the defective stator.

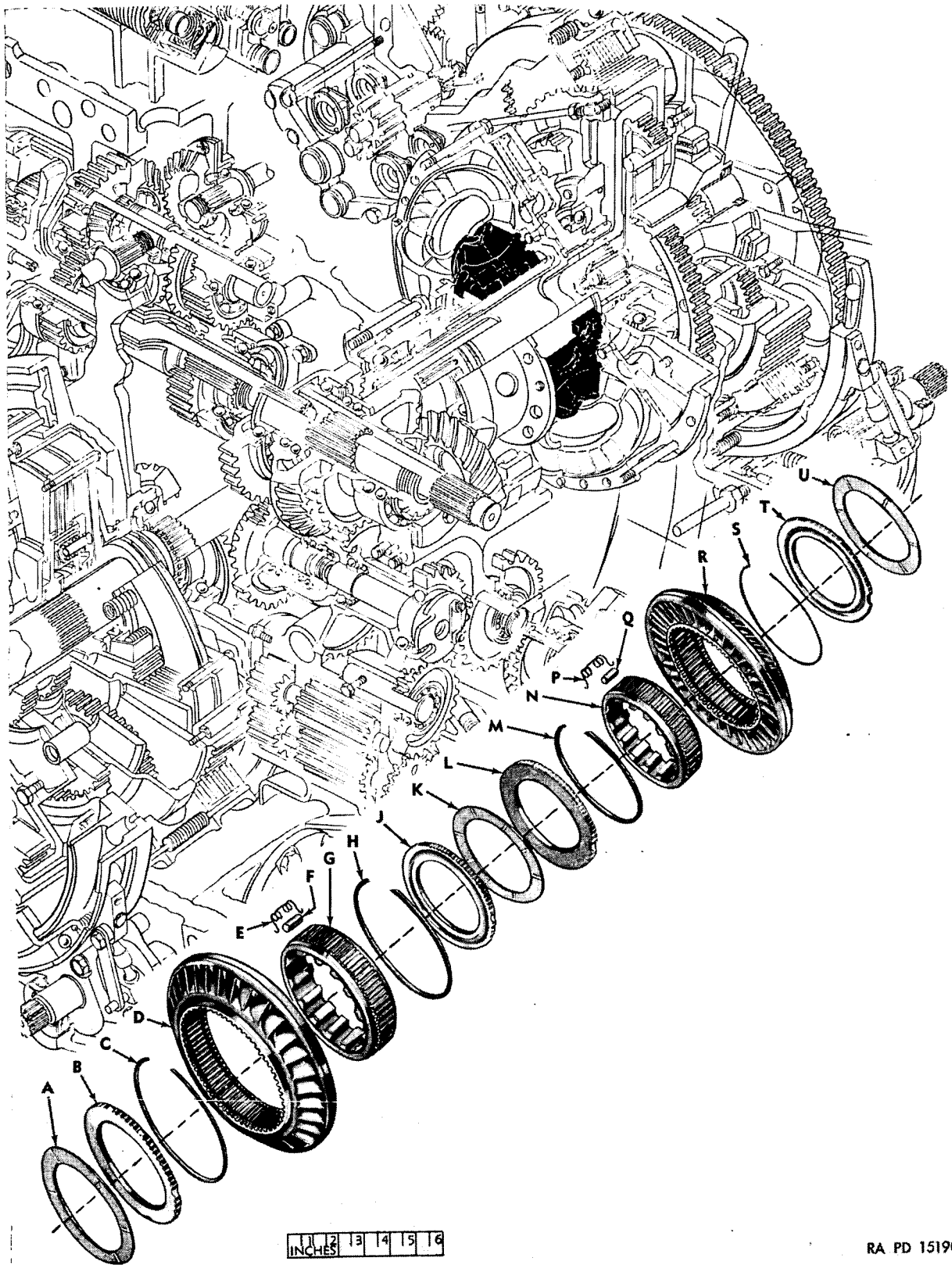
43. Assembly of Torque Converter

a. STATORS.

- (1) Determine which is the first stator by placing both staters on the assembly table with the internal faces up. The first stator's vanes spiral from the center in a clockwise direction (fig. 181). Install the snap ring in the lower groove of the first stator if it has been removed. Make sure it is all the way in the groove. Install the stator cam in the first stator with the low side of the cam roller slots in the direction of the vane's spiral (fig. 182). Install the snap ring in the upper groove of the first stator. Make sure it is fitted in the groove properly. Apply heavy grease to the stator-hub spacer and install it on the external face of the first stator. Install the spacer with the grooved side next to the stator hub.

- (2) Place the arbor (41-A-339-24) on the assembly table with the pilot end up. Place two wooden blocks on either side of the tool and set the first stator, over the arbor, on the blocks. Set the stator on the blocks with its internal face up. Install 14 springs in the first stator cam, using a small hex wrench or wire that will fit into both coils of the springs. Make sure both coils of each spring go into the grooves and the two wire ends of each spring go into the slots (fig. 183). Install the 14 freewheel rollers in the first stator between the spring and the arbor (41-A-339-24) (fig. 184). Install the other stator-hub spacer with the grooved side next to the stator. Install the thrust washer.

- (3) Lay the second stator on the assembly



RA PD 151909

Figure 170. First and second stator assemblies—exploded view.

A—THRUST WASHER GM-6760281
 B—STATOR HUB SPACER GM-6765654
 C—SNAP RING GM-6763943
 D—SECOND STATOR GM-6763942
 E—FREEWHEEL SPRING (14) GM-6765673
 F—FREEWHEEL ROLLER (14) GM-6765648
 G—STATOR CAM GM-6765653
 H—SNAP RING GM-6763943
 J—STATOR HUB SPACER GM-6765654
 K—THRUST WASHER GM-6760281
 L—STATOR HUB SPACER GM-6765654
 M—SNAP RING GM-6763943
 N—STATOR CAM GM-6765653
 P—FREEWHEEL SPRING (14) GM-6765673
 Q—FREEWHEEL ROLLER (14) GM-6765648
 R—FIRST STATOR GM-6763941
 S—SNAP RING GM-6763943
 T—STATOR HUB SPACER GM-6765654
 U—THRUST WASHER GM-6760281

Figure 170—Continued.

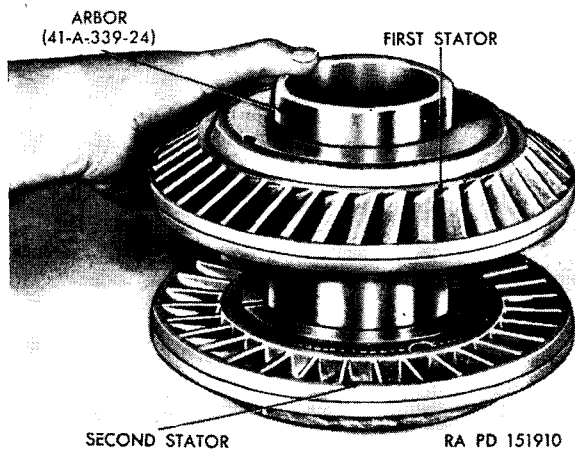
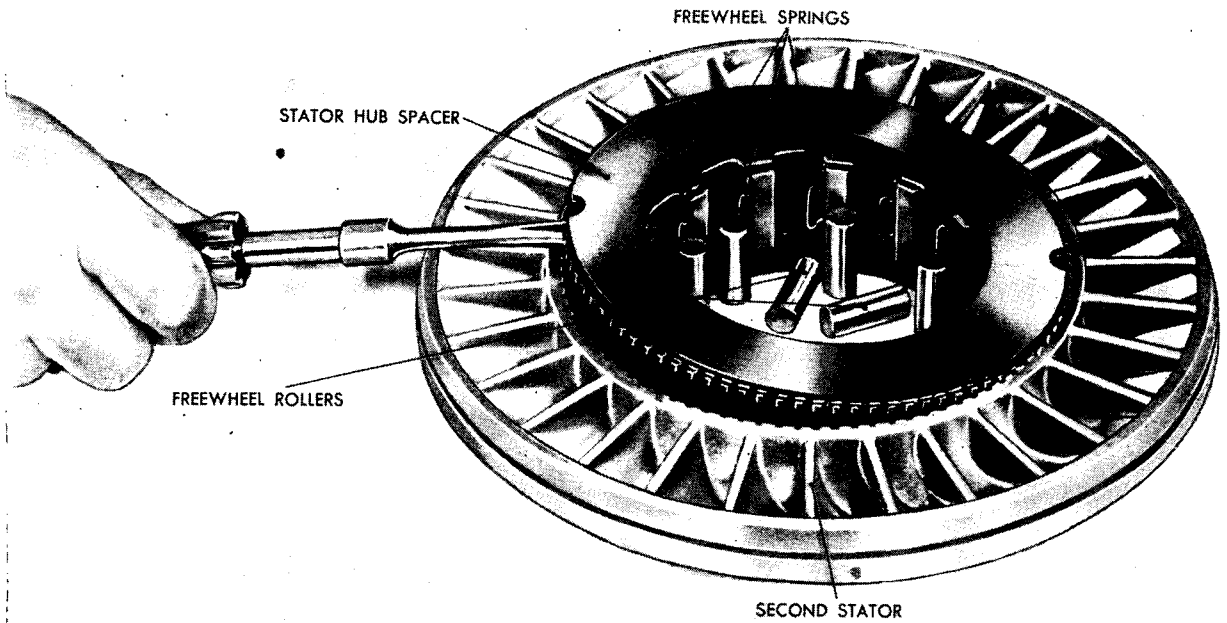
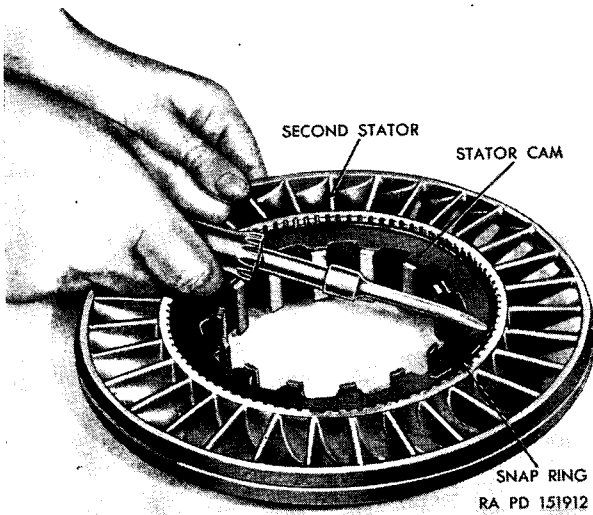


Figure 171. Separating first and second stators.



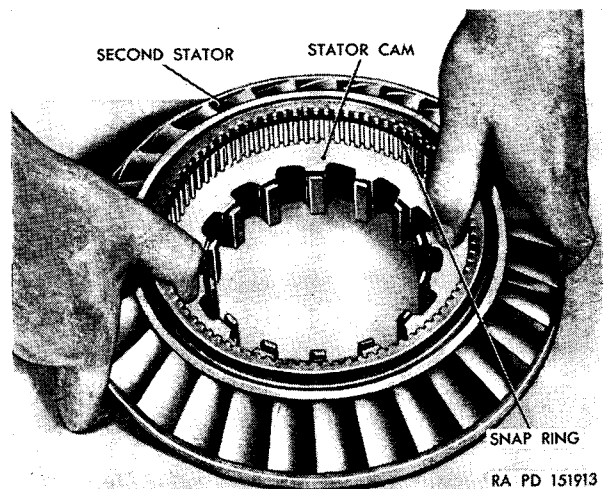
RA PD 151911

Figure 172. Removing stator-hub spacer.



RA PD 151912

Figure 173. Removing stator snap ring.



RA PD 151913

Figure 174. Pressing out stator cam.

table with the internal face up and the snap ring in place in the lower groove. The second stator's vanes spiral from the center in a counterclockwise direction (fig. 181). Install the stator cam in the second stator with the low side of the cam roller slots in the direction of the vane's spiral. Install the snap ring in the upper groove. Make sure it is all the way in the groove. Apply heavy grease to the stator-hub spacer and install it on the internal face of the second stator. Install it with the grooved side next to the stator hub.

- (4) The first stator should be lowered on the arbor (41-A-339-24) and blocked up to allow the second stator to be installed. Install the second stator, internal face down, on the arbor (fig. 185). Install the 14 freewheel springs and rollers in the second stator, following the same procedure used with the first stator. Install the stator hub spacer on the second stator, grooved side down.

b. PUMP.

- (1) Install the ring in the converter pump hub.

- Block up the converter pump on the assembly table with the internal face up.
- (2) Using a soft hammer, tap in the pump hub. Install the snap ring on the pump (fig. 176).

c. LOCK-UP CLUTCH HOUSING.

- (1) Place the lock-up clutch housing on the assembly table with the bearing up. Install the converter pump drive gear with its numbers up (fig. 180). Secure it with eight $\frac{5}{16}$ -inch bolts. Torque the bolts 17 to 20 pound-feet.
- (2) Turn the assembly over on the gear side and install the converter lock-up clutch piston (fig. 179). Aline the dowels with the dowel holes. Install the lock-up clutch plate (fig. 178). Coat the thrust washer (fig. 178) with heavy grease and install it on the lock-up clutch-housing hub. Make sure the gasket is on the housing.
- (3) Install the lock-up clutch main plate with the backing plate surface next to the lock-up clutch plate. Install two bolts to aline the holes and tap the lock-up clutch-main plate into place.

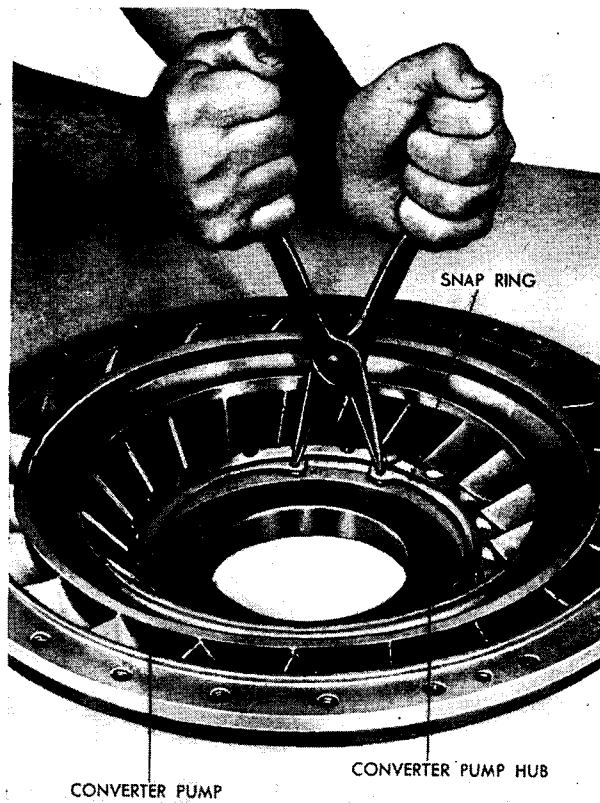


Figure 175. Torque converter assembly—exploded view.

RA PD 151914

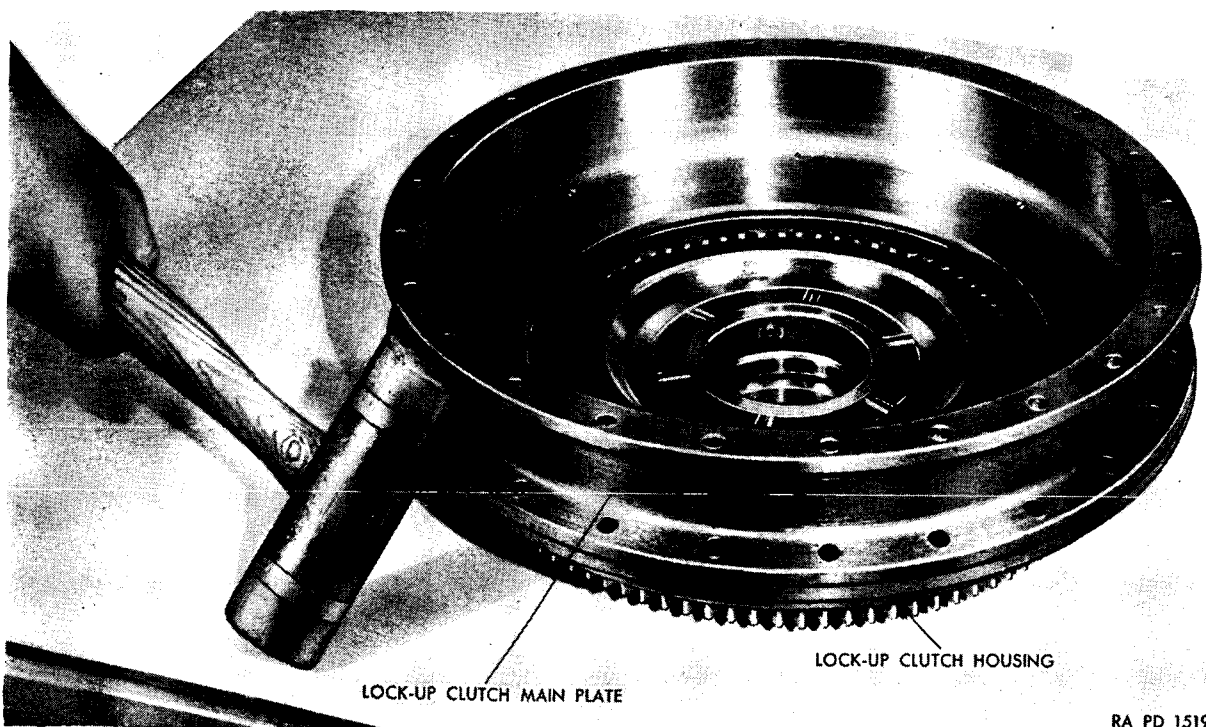
A—"O" RING GASKET GM-6750176
 B—OIL TRANSFER SLEEVE GM-6760280
 C—CONVERTER GROUND SLEEVE GM-6763920
 D—PIN GM-6765366
 E—BOLT (6) GM-6765296
 F—LOCKING WIRE GM-6704501
 G—RING GM-6763957
 H—PUMP SEAL ASSEMBLY GM-6765392
 J—SCREW (3) GM-113911
 K—PUMP FLANGE RETAINER RING GM-6763384
 L—CONVERTER PUMP GM-6765030
 M—RING GM-6765392
 N—"O" RING GASKET GM-6765392
 P—PIN (3) GM-141105
 Q—CONVERTER PUMP HUB GM-6765437
 R—SNAP RING GM-6765432
 S—PUMP HUB SLEEVE GM-6765652
 T—FIRST AND SECOND STATOR ASSEMBLIES
 U—STATOR RETAINER GM-6763882
 V—LOCATING BALL GM-147483
 W—SNAP RING GM-6763940
 X—SNAP RING GM-6762323
 Y—HOOK TYPE SEAL RING GM-6765267
 Z—CONVERTER TURBINE ASSEMBLY GM-6763897
 AA—HOOK TYPE SEAL RING GM-6765367
 BB—GASKET (2) GM-6763881
 CC—LOCK-UP CLUTCH MAIN PLATE GM-6763893
 DD—LOCK-UP CLUTCH PLATE GM-6763776
 EE—LOCK-UP CLUTCH PISTON GM-6763787
 FF—"O" RING GASKET GM-6764163
 GG—"O" RING GASKET GM-6750815
 HH—PIN (3) GM-6762874
 JJ—LOCK-UP CLUTCH HOUSING ASSEMBLY GM-6765783
 KK—BOLT (24) GM-186303
 LL—BOLT (8) GM-192352
 MM—CONVERTER PUMP DRIVE GEAR GM-6763782 (1.4 TO 1 RATIO)
 GM-6763784 (1.3 TO 1 RATIO)
 NN—BEARING GM-451734
 PP—SEAL RING GM-6765405

Figure 175—Continued.



RA PD 151915

Figure 176. Removing or installing converter pump snap ring.



RA PD 151916

Figure 177. Removing lock-up clutch main plate.

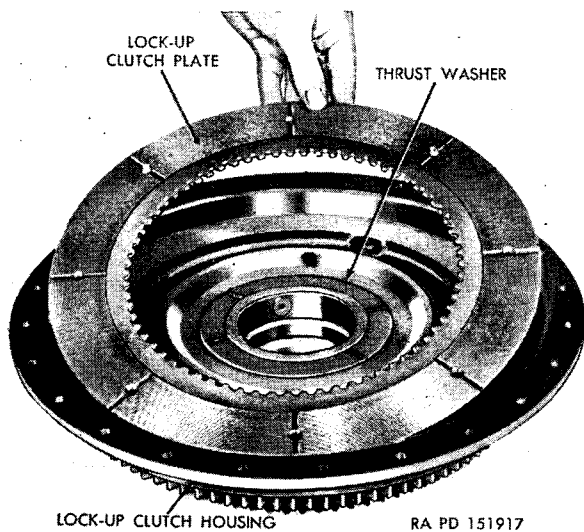


Figure 178. Removing or installing lock-up clutch plate.

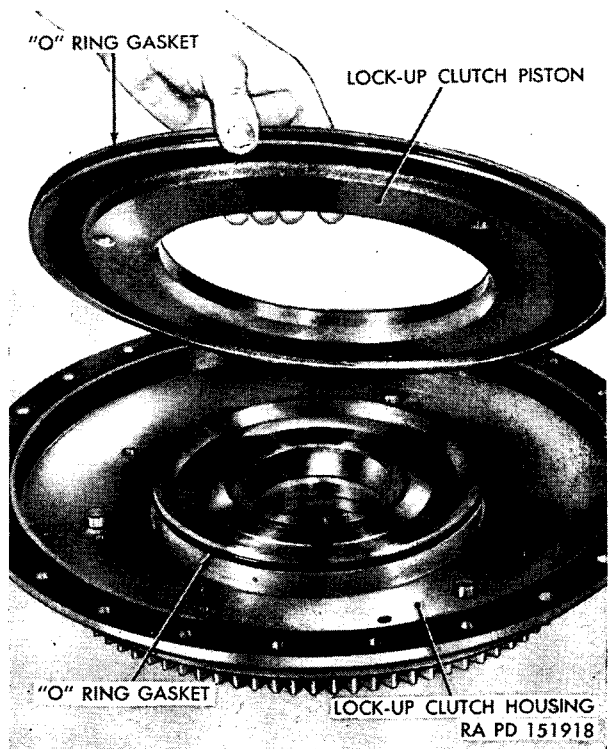


Figure 179. Removing or installing lock-up clutch piston.

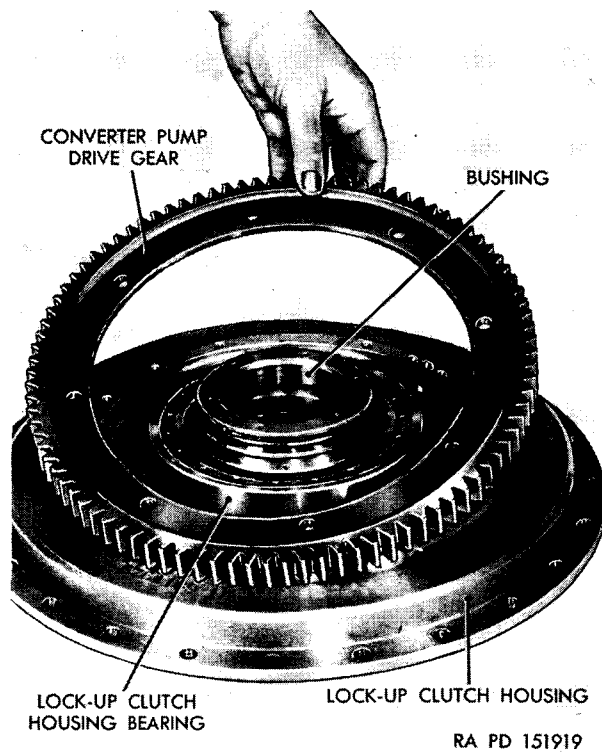


Figure 180. Removing or installing converter-pump drive gear.

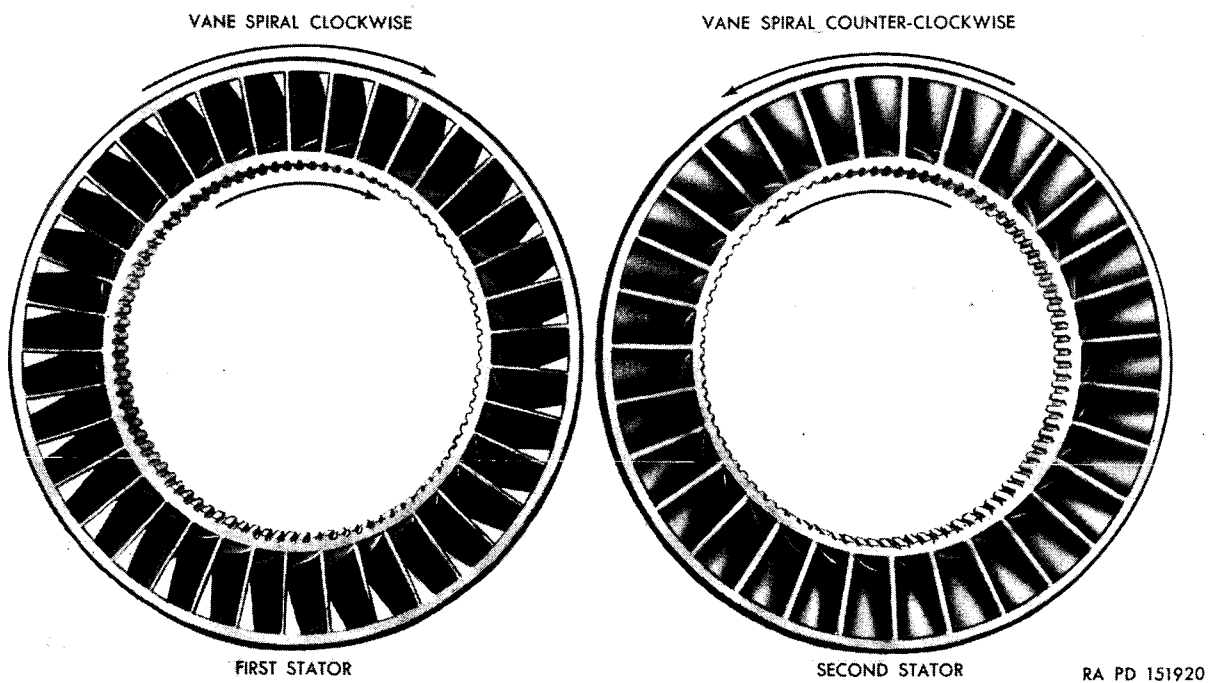
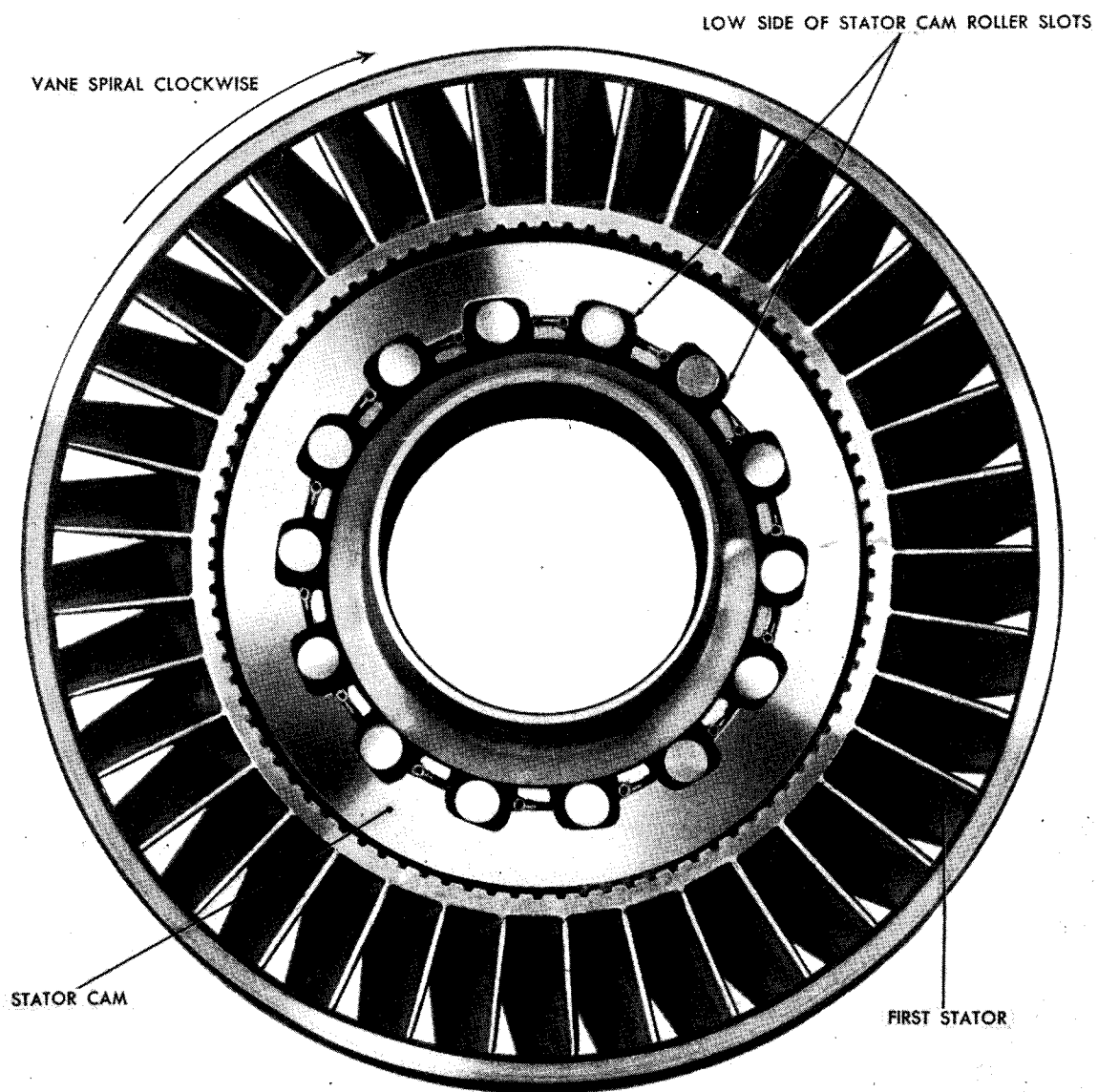


Figure 181. Identification of first and second stators.



RA PD 151921

Figure 182. First stator cam properly installed.

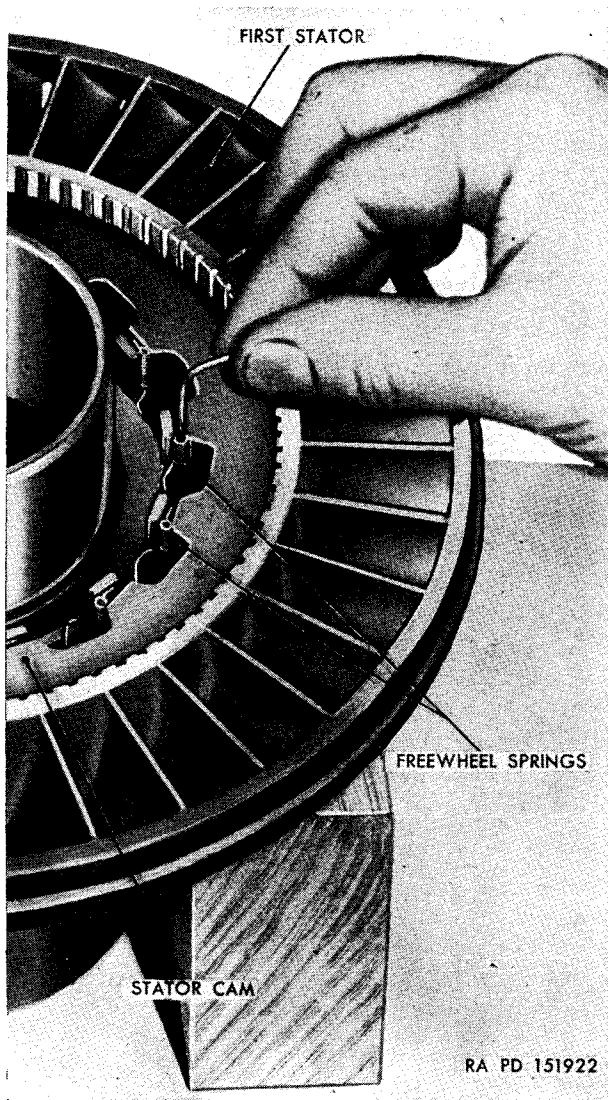


Figure 183. Installing stator springs.

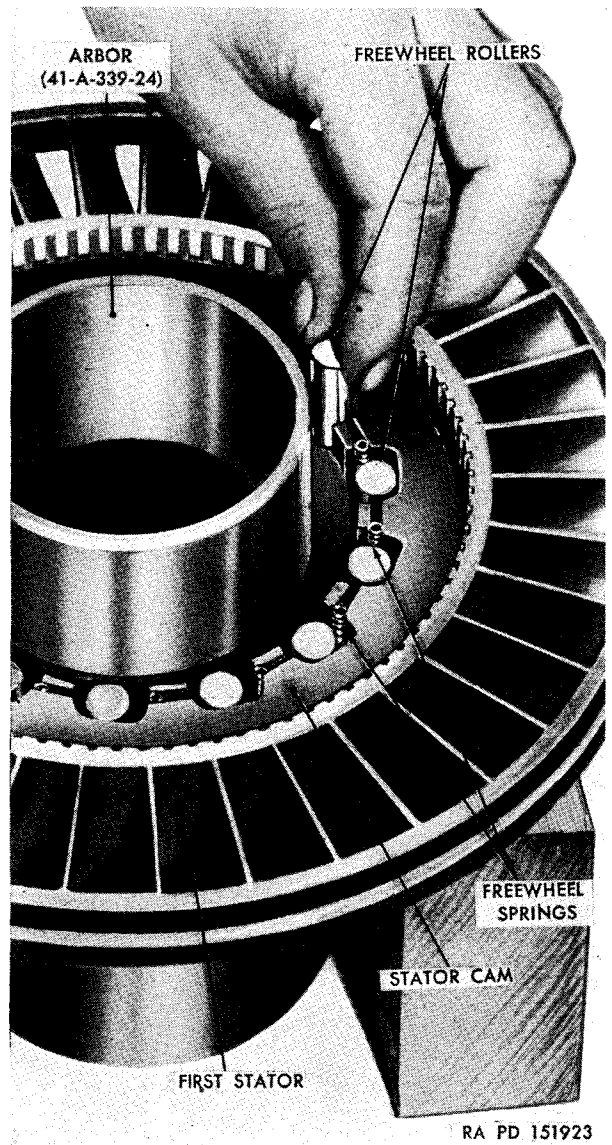


Figure 184. Installing stator rollers.

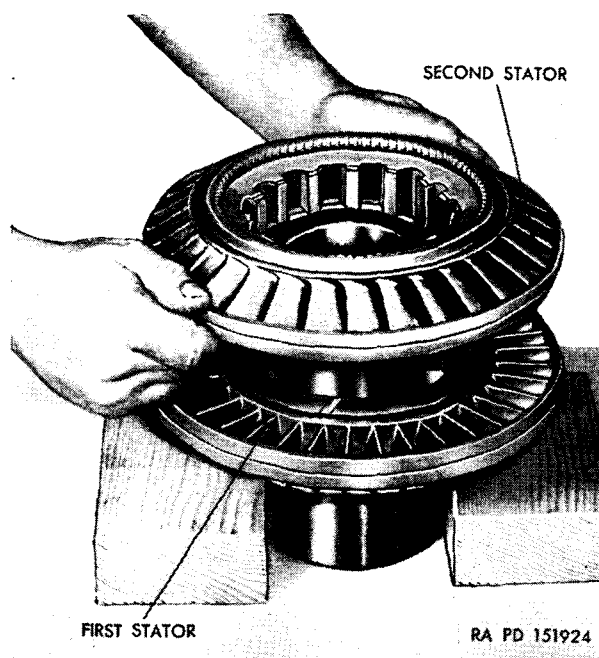


Figure 185. Installing second stator.

Section VIII. REBUILD OF RIGHT END COVER

44. Disassembly of Right End Cover

a. GENERAL. The disassembly of the right end cover (fig. 186) is identical to that of the left end cover (par. 32) except for the steps that concern the converter lock-up governor and the lock-up governor relay valve.

b. CD-500-3 RIGHT END COVER. After disassembling the end cover, remove the speedometer-drive-shaft plug and gasket, using a $\frac{3}{8}$ -inch wrench. Remove the dummy-speedometer drive shaft. Remove the speedometer-drive cover (fig. 17) and gasket by removing four jam nuts, nuts, and washers, using a $\frac{1}{8}$ -inch wrench.

c. CD-500-4 RIGHT END COVER. After disassembling the end cover, remove the speedometer-drive-shaft plug and gasket, using a $\frac{3}{8}$ -inch wrench. Remove the speedometer-drive shaft and gear. Using a $\frac{1}{8}$ -inch wrench, remove the four jam nuts, nuts, and washers that secure the speedometer-drive adapter to the end cover. Remove the speedometer-drive adapter, gasket, and the speedometer-drive-adaptor shaft. Remove the speedometer-drive housing assembly and gasket. This assembly consists of the speedometer-drive housing, washer, oil seal, speedometer drive shaft, and speedometer driven gear.

45. Cleaning

Refer to paragraph 25 for cleaning instructions.

46. Inspection and Repair

a. GENERAL. Refer to paragraph 26*a* through *l* for general inspection and repair procedure. Refer to paragraph 98 for serviceability measurements and wear limits.

b. Refer to paragraph 34*b* through *e* for specific procedures.

47. Assembly of Right End Cover

a. GENERAL. The assembly of the right end cover is identical to that of the left end cover (par. 35) except for the steps that concern the converter lock-up governor and the lock-up governor relay valve.

b. CD-500-3 RIGHT END COVER. Install the speedometer-drive cover and gasket. Secure with four $\frac{1}{4}$ -inch jam nuts, nuts, and washers. After the end cover has been installed on the transmission, install the dummy speedometer drive shaft, indexing the torque with the slot in the speedometer-drive coupling. Install the plug and copper gasket.

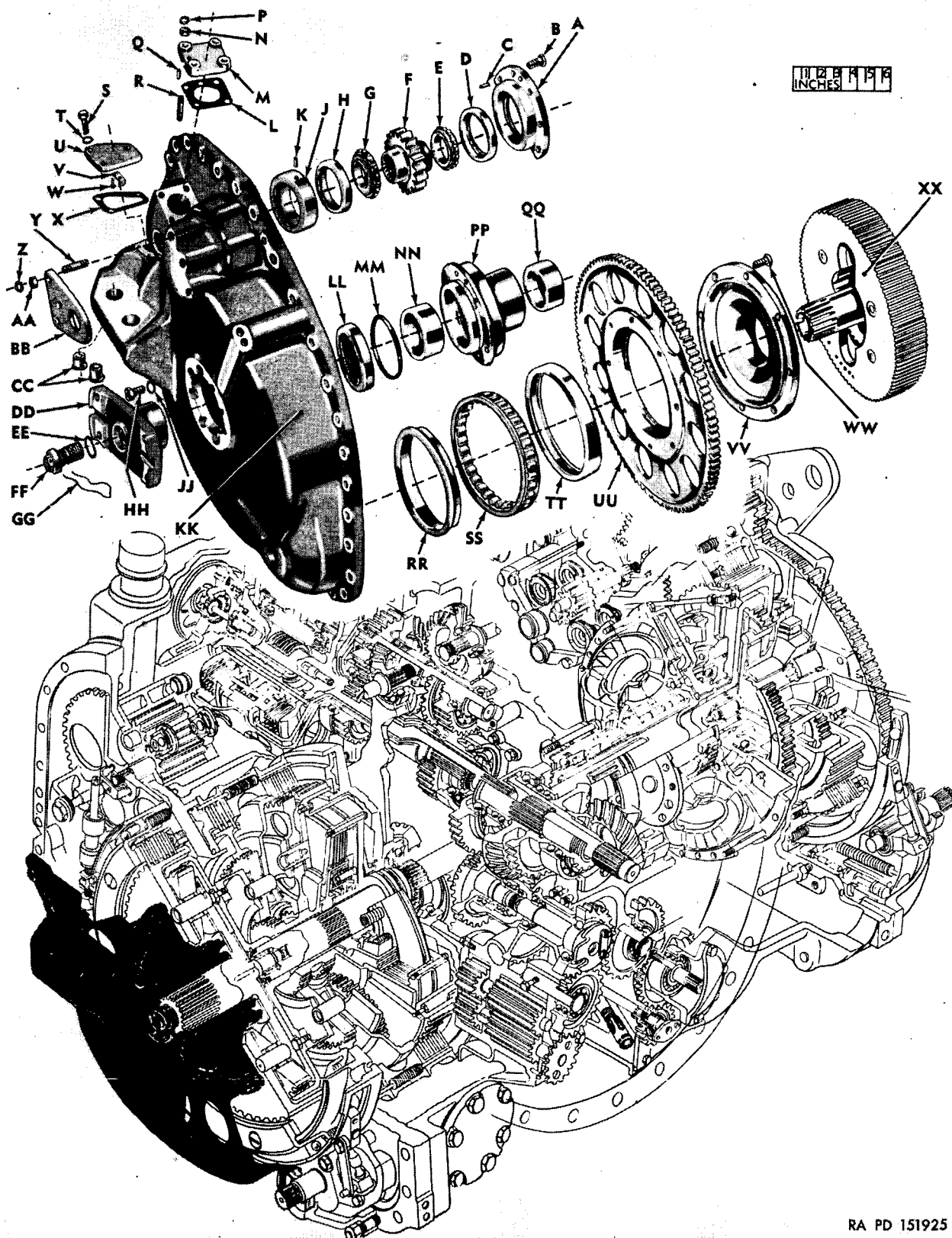


Figure 186. Right end cover assembly—exploded view.

A—INNER BEARING CAGE GM-6704161
 B—BOLT (5) GM-192099
 C—PIN GM-110409
 D—OUTER RACE GM-7450040
 E—INNER RACE AND ROLLERS GM-7450040
 F—STEERING OUTPUT PINION GEAR GM-6704110
 G—INNER RACE AND ROLLERS GM-7450040
 H—OUTER RACE GM-7450040
 J—CAGE GM-6704145
 K—PIN GM-141221
 L—GASKET GM-6762910
 M—SPEEDOMETER DRIVE COVER GM-6764992
 N—NUT (4) GM-137508
 P—JAM NUT (4) GM-147508
 Q—PIN GM-141105
 R—STUD (4) GM-6762165
 S—BOLT (3) GM-221583
 T—WASHER (3) GM-103340
 U—COVER GM-6765473
 V—PLATE GM-6765474
 W—RIVET (2) GM-135267
 X—GASKET GM-6763959
 Y—STUD (3) GM-6764056
 Z—JAM NUT (3) GM-145493
 AA—NUT (3) GM-103028
 BB—BRACKET GM-6764055
 CC—BUSHING GM-6704442
 DD—RIGHT OUTPUT FLANGE ASSEMBLY GM-6704103
 EE—WASHER GM-889295
 FF—OUTPUT FLANGE RETAINER SCREW GM-6762008
 GG—LOCKING WIRE 22-W-1630
 HH—BOLT (8) GM-192094
 JJ—WASHER (8) GM-103341
 KK—RIGHT END COVER GM-6763953
 LL—OUTPUT FLANGE OIL SEAL GM-6704106
 MM—SEAL RING GM-6760886
 NN—OUTPUT FLANGE BUSHING GM-6704107
 PP—END COVER HUB GM-6704104
 QQ—OUTPUT SHAFT BUSHING GM-6704167
 RR—INNER RACE GM-6761442
 SS—ROLLERS GM-6761442
 TT—OUTER RACE GM-6761442
 UU—STEERING OUTPUT GEAR GM-6764061
 VV—OUTPUT SUN GEAR GM-6704118
 WW—BOLT (8) GM-190768
 XX—CARRIER ASSEMBLY, OUTPUT PLANET GM-6765353

Figure 186—Continued.

c. CD-500-4 RIGHT END COVER. Install the speedometer-drive housing assembly and gasket. This assembly consists of the speedometer-drive housing, washer, oil seal, speedometer drive shaft, and speedometer driven gear. Install the speedometer-drive-adapter shaft, gasket, and speed-

ometer-drive adapter. Secure with four ¼-inch jam nuts, nuts, and washers. After the end cover has been installed on the transmission, install the speedometer drive shaft and gear, indexing the torque with the slot in the speedometer-drive coupling. Install the plug and copper gasket.

Section IX. REBUILD OF RIGHT END PLATE AND DRIVE CLUTCH PACKAGE UNIT

48. Disassembly of Right End Plate and Drive Clutch Unit

a. END PLATE.

- (1) The right brake was disassembled in paragraph 23i.
- (2) Suspend the end plate assembly from a hoist, resting the bottom of the end plate on the teardown table.
- (3) Remove the speedometer-drive coupling from the center of the output-sump-pump drive gear with a screwdriver (fig. 187). Using a ⅝-inch wrench, remove the pump-gear retaining nut and remove the pump drive gear from the splined shaft.
- (4) Using a ⅝-inch wrench, remove 10 of the 12 package unit bolts that extend through the end plate, package unit, and the reverse-range cover assembly (fig. 188), leaving two bolts 180 degrees apart on the bolt circle. Loosen, but do not remove, the remaining two bolts.
- (5) Lower the end plate assembly to the assembly table, resting the assembly on the output-ring gear.

b. REVERSE-RANGE CLUTCH HOUSING.

- (1) Using snap ring pliers, remove the snap ring from the high-range clutch housing (fig. 189). Lift off the spacer. Remove the thrust washer. Remove the two bolts remaining in the package unit, using a ⅝-inch wrench.
- (2) Use a soft hammer to free the reverse-range-clutch housing (fig. 190) from the oil transfer tubes. Lift off the reverse-range-clutch housing. Remove the reverse-range-clutch piston (fig. 191).

Note. There is a thrust washer located between the reverse-range-housing hub and the

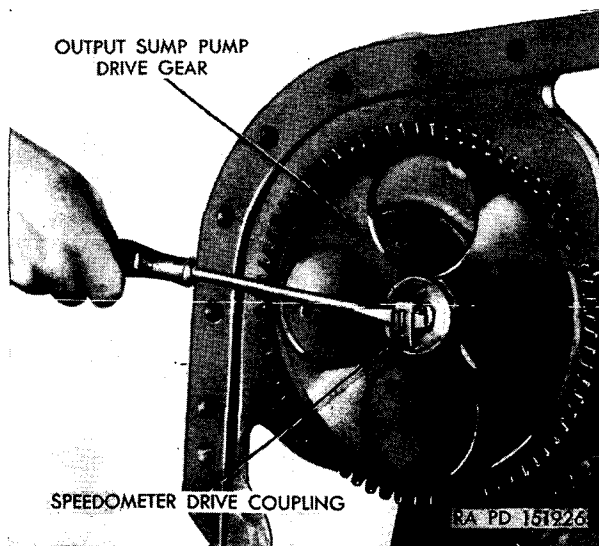


Figure 187. Removing speedometer-drive coupling.

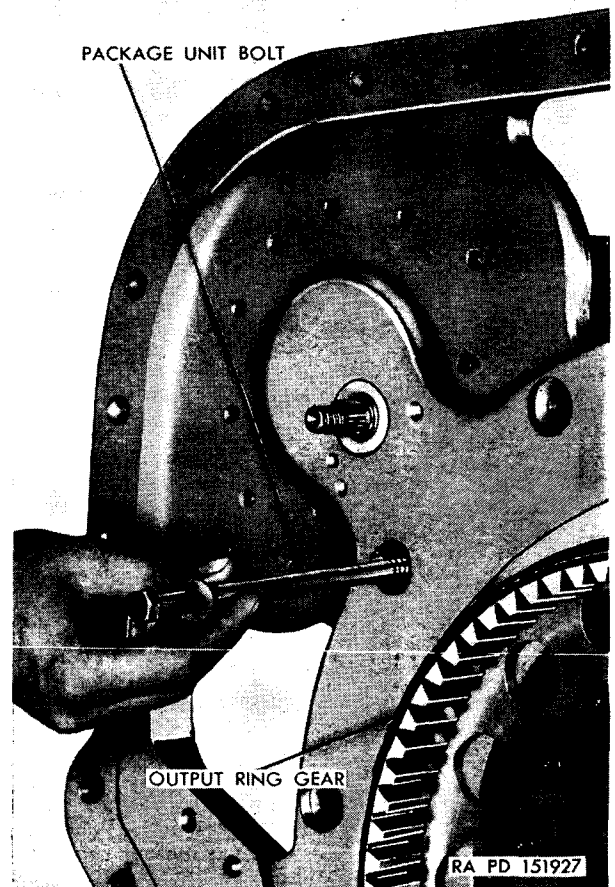


Figure 188. Removing package unit bolts.

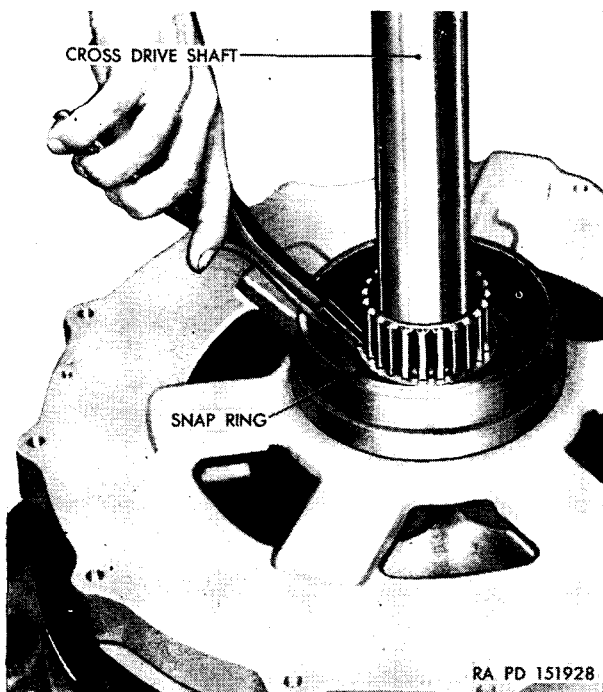


Figure 189. Removing or installing clutch-housing snap ring.

reverse-range hub. This thrust washer as well as the reverse-range clutch piston may tend to stay with the reverse-range housing. Be careful not to drop them when removing the housing. When handling clutch pistons, be careful not to damage the seal rings.

c. REVERSE-RANGE CLUTCH HUB.

- (1) Using a $\frac{1}{2}$ -inch wrench, remove the 24 bolts that secure the reverse-range-clutch-hub assembly to the reverse-range planet carrier. Loosen the reverse-range clutch hub from the planet carrier by using screwdrivers or pry bars between the hub and the high-range-clutch housing. At the same time, tap on the high-range clutch housing with a soft hammer or drift (fig. 192). Remove the reverse-range hub, being careful not to drop the thrust washer.
- (2) Remove the thrust washer from the high-range-clutch housing (fig. 193). Lift out the 11 disks in the reverse-range-clutch disk pack (fig. 194). Remove the reverse-range-clutch ring, using a soft hammer (fig. 195).

d. HIGH-RANGE CLUTCH HOUSING.

- (1) Using a $\frac{1}{2}$ -inch wrench, remove the 20 bolts from the high-range-clutch housing. Lift out the high-range-clutch housing

assembly being careful not to drop the thrust washer if it should stay with the housing.

Note. The high-range-clutch housing contains the high-range-clutch-piston and-return springs.

- (2) Remove the thrust washer and lift out the high-range-clutch hub, (fig. 196) being careful not to drop the thrust washer. Lift out the high-range-clutch disk pack (fig. 197). Remove the thrust washer from the high-range pinion.
 - (3) Remove the cross-drive shaft (fig. 198).
- #### e. REVERSE-RANGE PLANETARY.
- (1) Remove the high-range pinion assembly, rotating it as it is lifted.
 - (2) Remove the two screws which secure the reverse-range back plate to the low-range back plate. Remove the reverse-range back plate (fig. 199) and the 12 reverse-range-piston-return pins and springs (figs. 200).
 - (3) Install two bolts in the reverse-range planet carrier. Take hold of the bolts and lift out the planet carrier (fig. 201).
 - (4) Using a $\frac{3}{8}$ -inch wrench, remove the 12 bolts that hold the reverse-range ring gear and low-range planet carrier together. With the aid of jack screws, separate and remove the reverse-range ring gear (fig. 202) from the low-range planetary carrier.

f. LOW-RANGE CLUTCH.

- (1) Remove the low-range back plate. Remove the 12 low-range piston-return pins from the back plate.
- (2) Remove the low-range-clutch-inner-pressure plate (bronze) (fig. 203). Remove the low-range ring gear assembly (fig. 204). Remove the low-range-clutch disk pack, consisting of five disks (fig. 205).
- (3) Lift off the low-range-clutch ring. Remove the low-range clutch piston (fig. 206).
- (4) Remove the 11 bolts from the output-sump pump, using a $\frac{1}{2}$ -inch wrench and remove the pump.

Note. Keep all the "O" ring gaskets and jumper tubes with the pump.

- (5) Lift the right end plate off the right-output-planetary ring gear and the low-range carrier assembly.

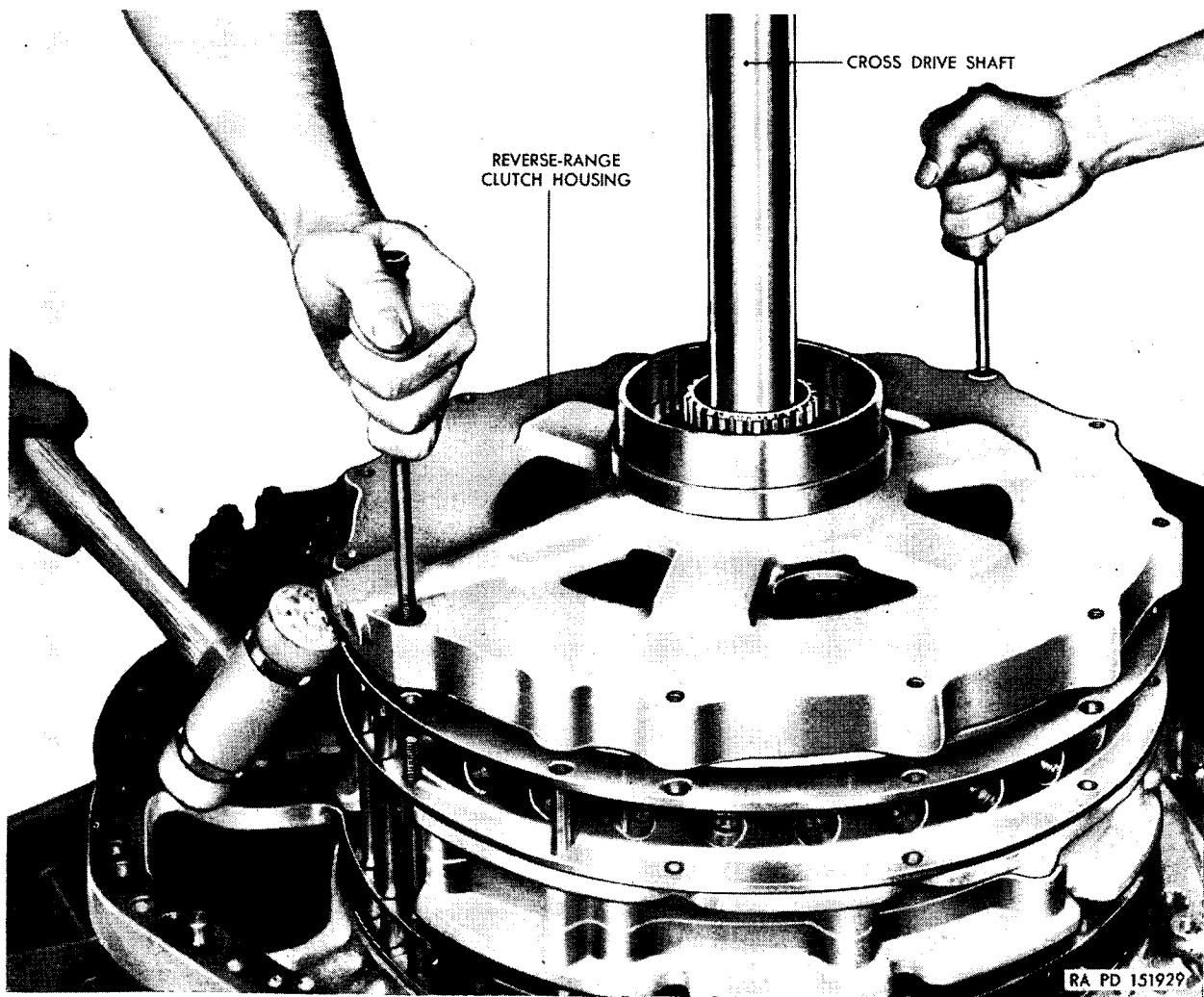


Figure 190. Freeing reverse-range-clutch housing.

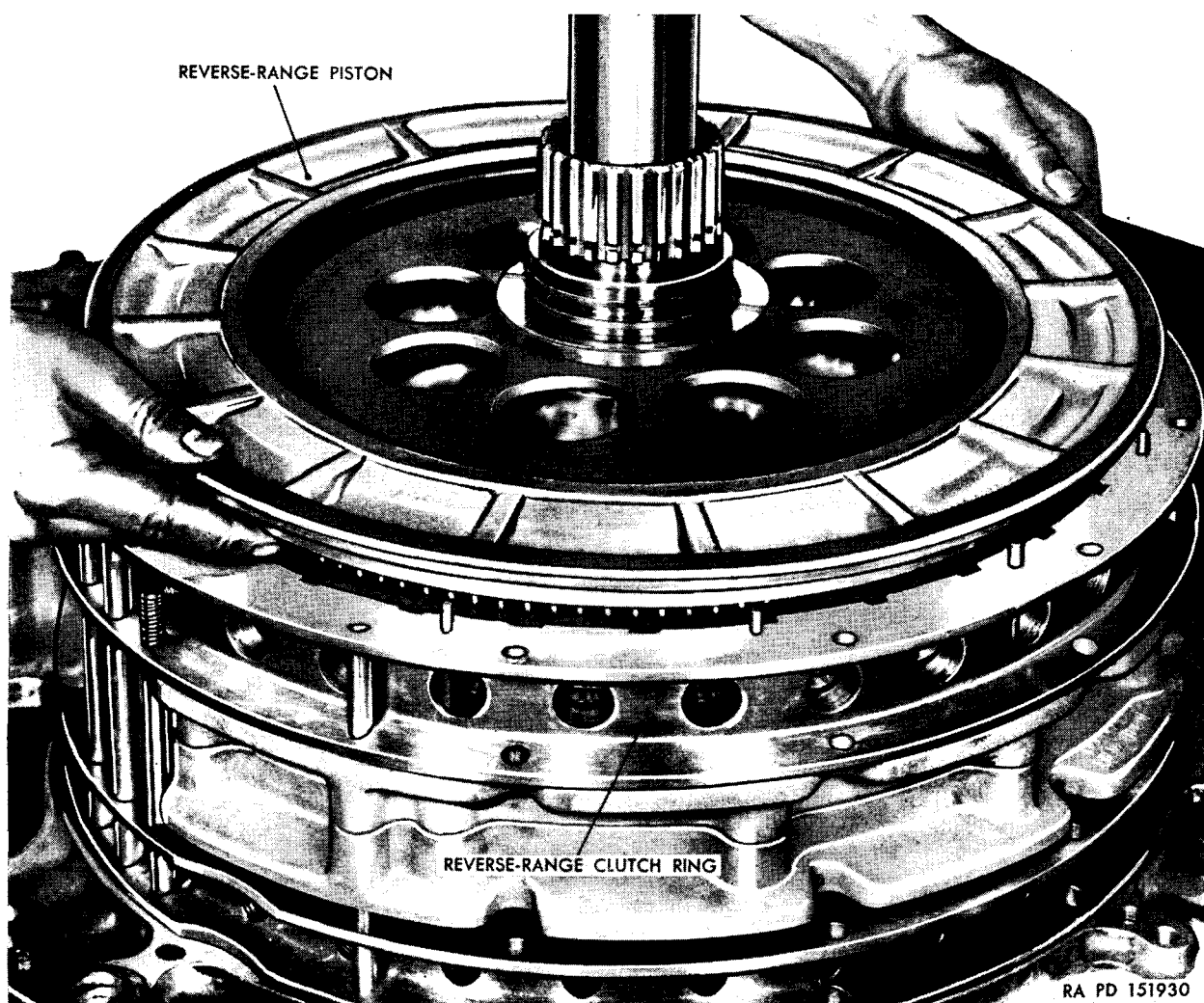


Figure 191. Removing reverse-range piston.

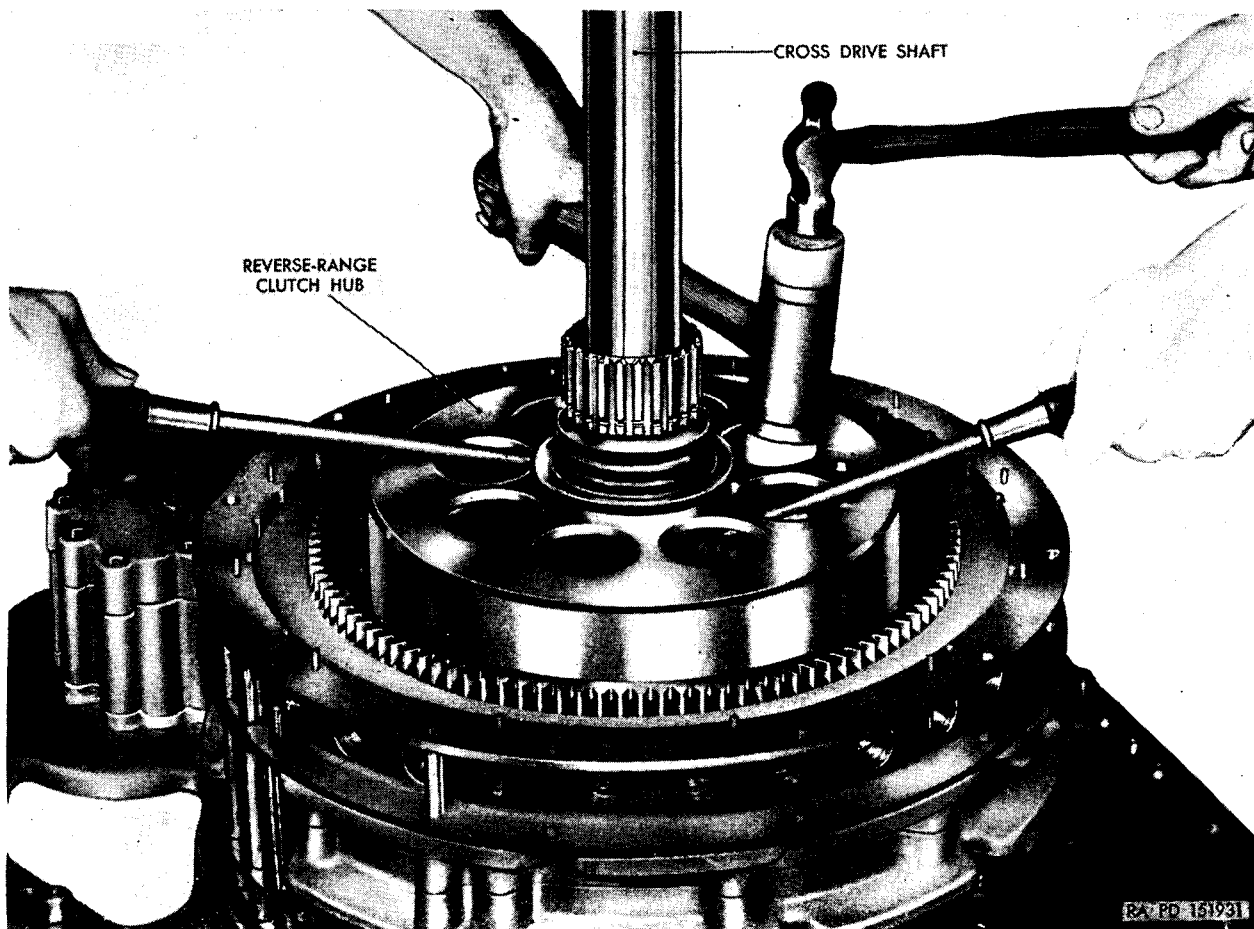


Figure 192. Loosening reverse-range hub.

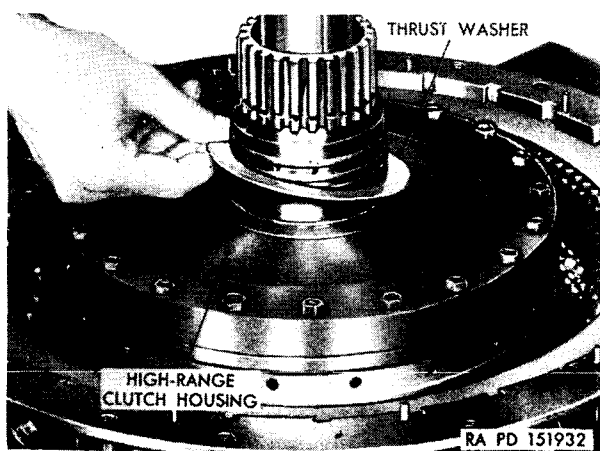


Figure 193. Removing thrust washer.

49. Cleaning

Refer to paragraph 25 for cleaning instructions.

50. Inspection and Repair

a. GENERAL. Refer to paragraph 26*a* through *l* for a general inspection and repair procedure. Refer to paragraph 100 for serviceability measurements and wear limits.

b. BRAKE ASSEMBLY. The right and the left brake assemblies are the same except that the brake signal valve is located in the left brake assembly. Refer to paragraph 38*d* through *h* for the inspection and repair procedure for the brake assembly and the brake actuating and adjusting mechanisms (fig. 207).

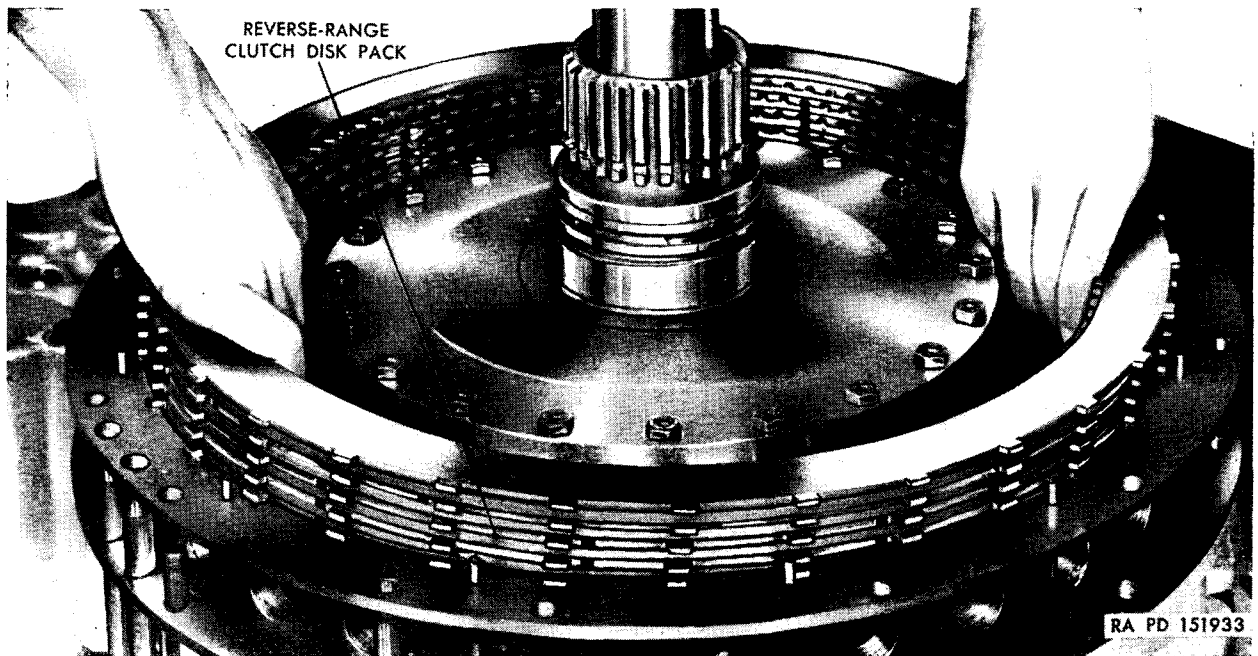


Figure 194. Removing reverse-range-clutch disk pack.

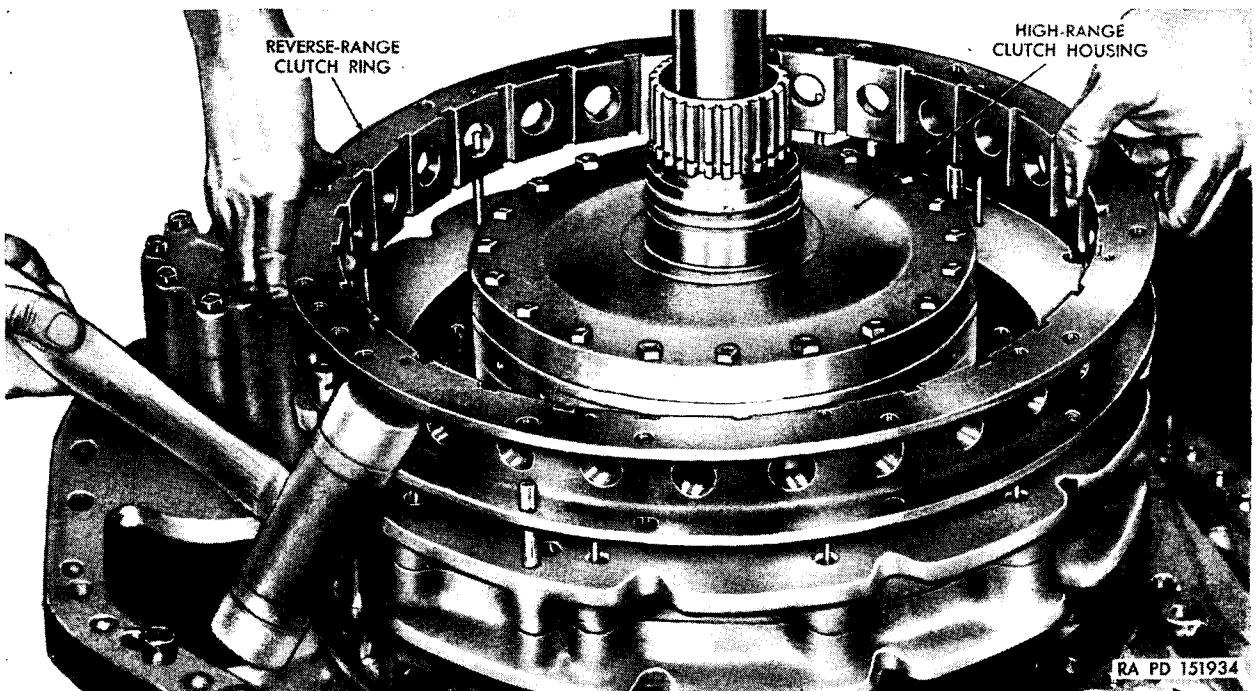


Figure 195. Removing reverse-range-clutch ring.

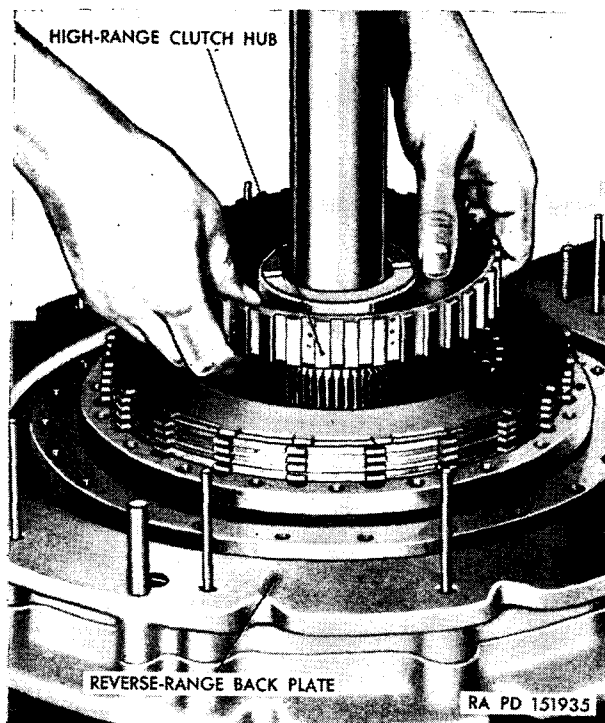


Figure 196. Removing or installing high-range-clutch hub.

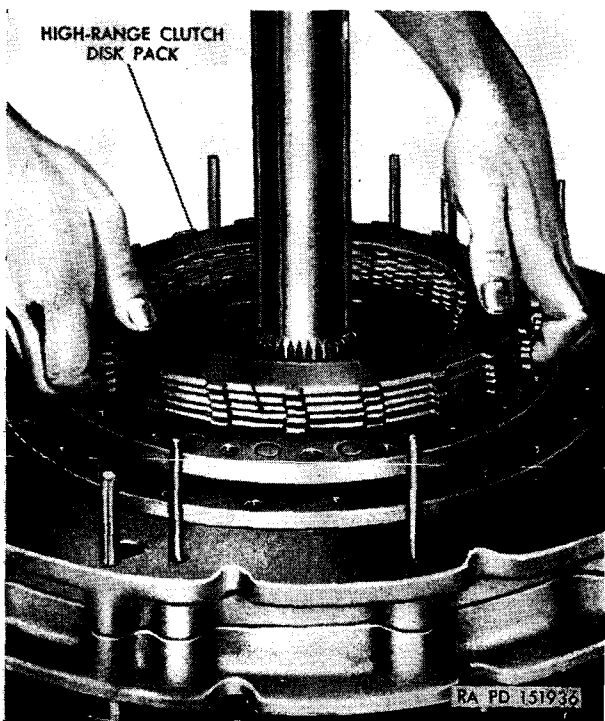


Figure 197. Removing high-range-clutch disk pack.

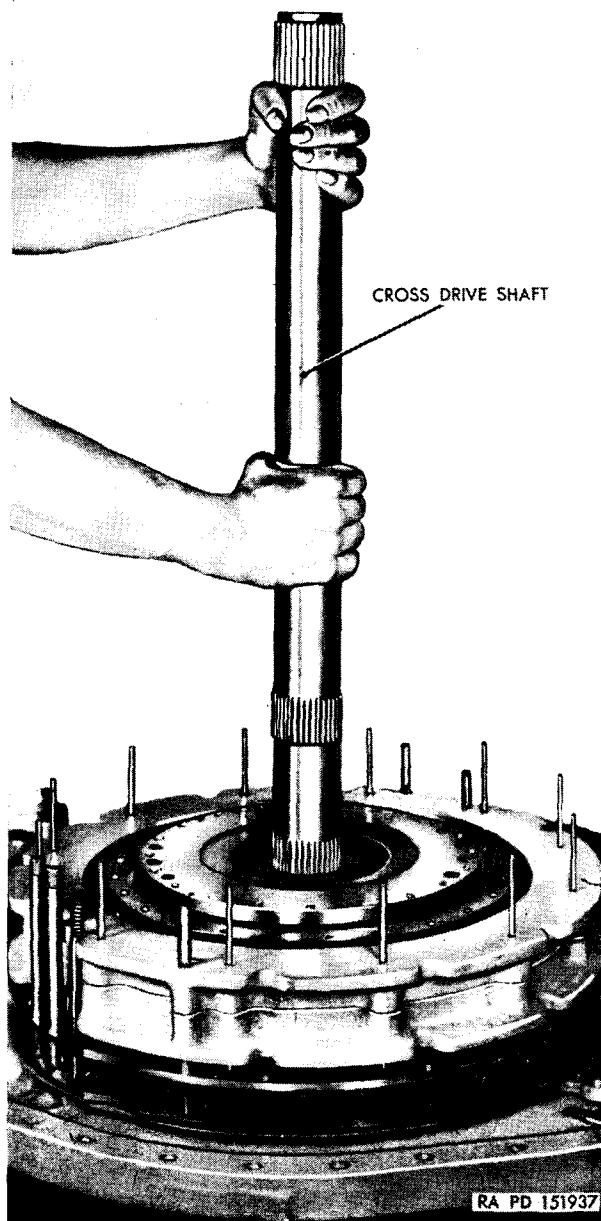


Figure 198. Removing or installing cross-drive shaft.

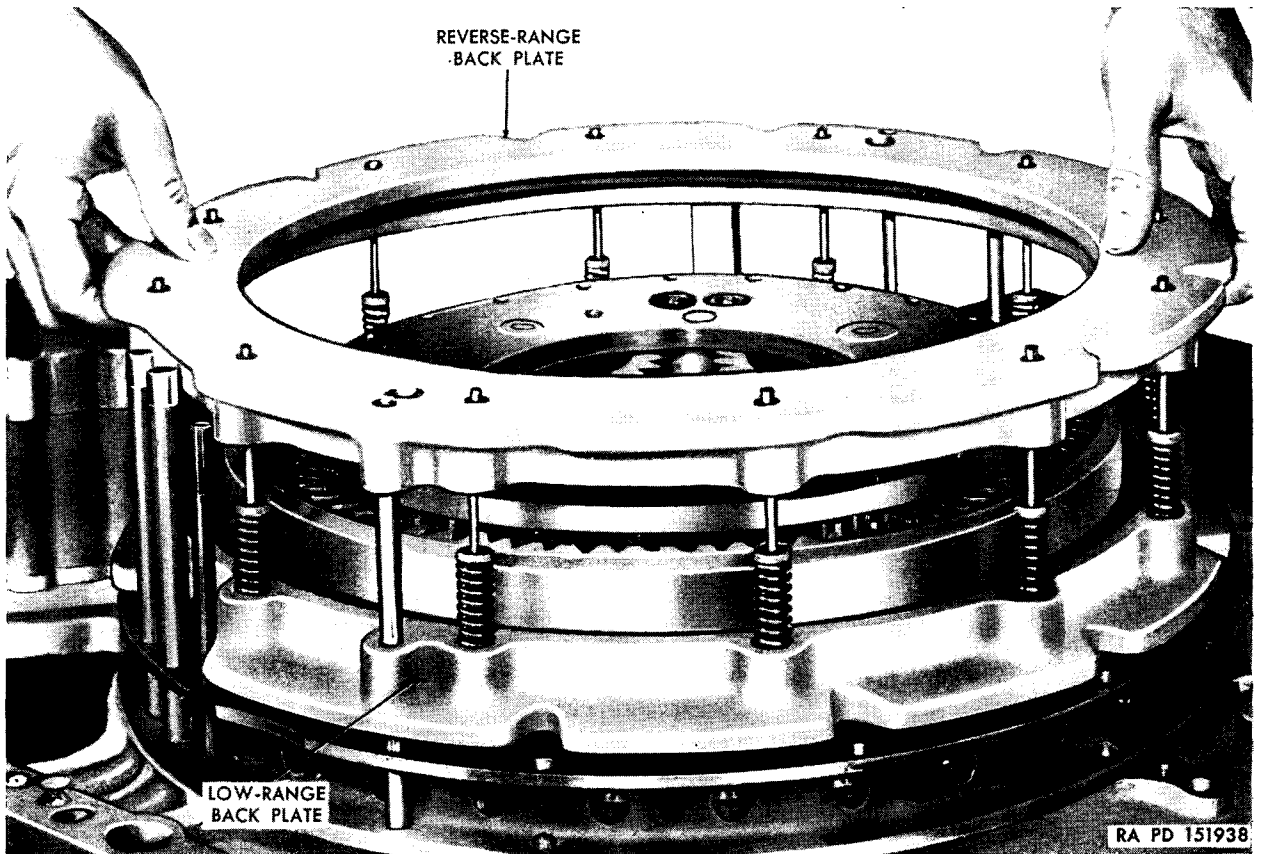


Figure 199. Removing or installing reverse-range back plate.

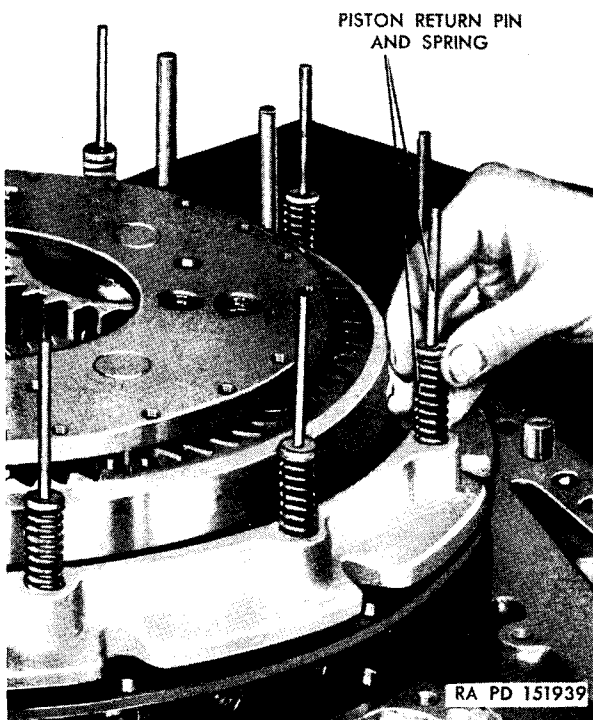


Figure 200. Removing piston return pins and springs.

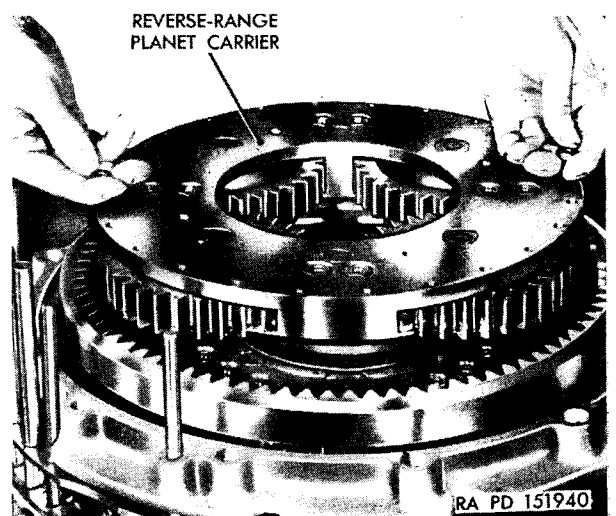


Figure 201. Removing or installing reverse-range planet carrier.

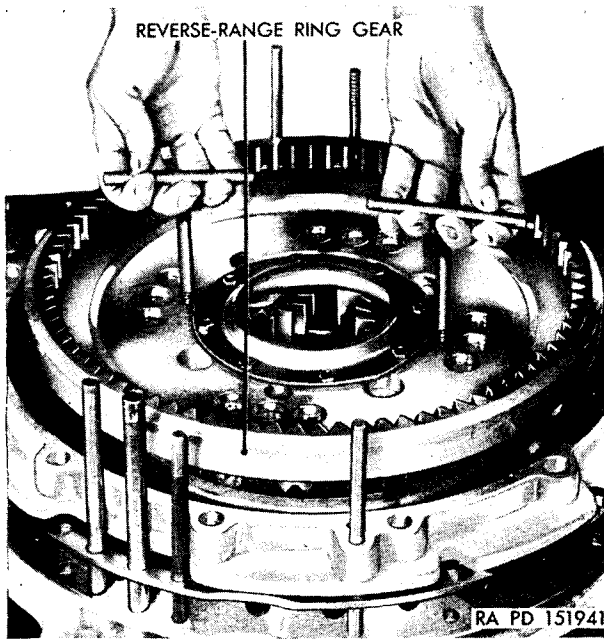


Figure 202. Removing reverse-range ring gear.

c. REVERSE-RANGE-CLUTCH HOUSING.

- (1) Inspect the reverse-range clutch housing and hub assembly (fig. 208). If it is necessary to remove the hub, use a $\frac{1}{2}$ -inch wrench to remove the six bolts and washers that secure the hub to the housing. Remove the hub by tapping on it with a soft hammer. Inspect the seal ring in the housing bore. Replace any defective parts.
- (2) To assemble, install the seal ring in the housing. Install the hub in the housing being careful to align the bolt holes in the hub with the bolt holes in the housing. Seat the hub in the housing using a soft hammer. Install the six $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet.

d. REVERSE-RANGE PISTON. Inspect the reverse-range piston and the inner and outer lip-type seal rings (fig. 208). Replace if defective. When

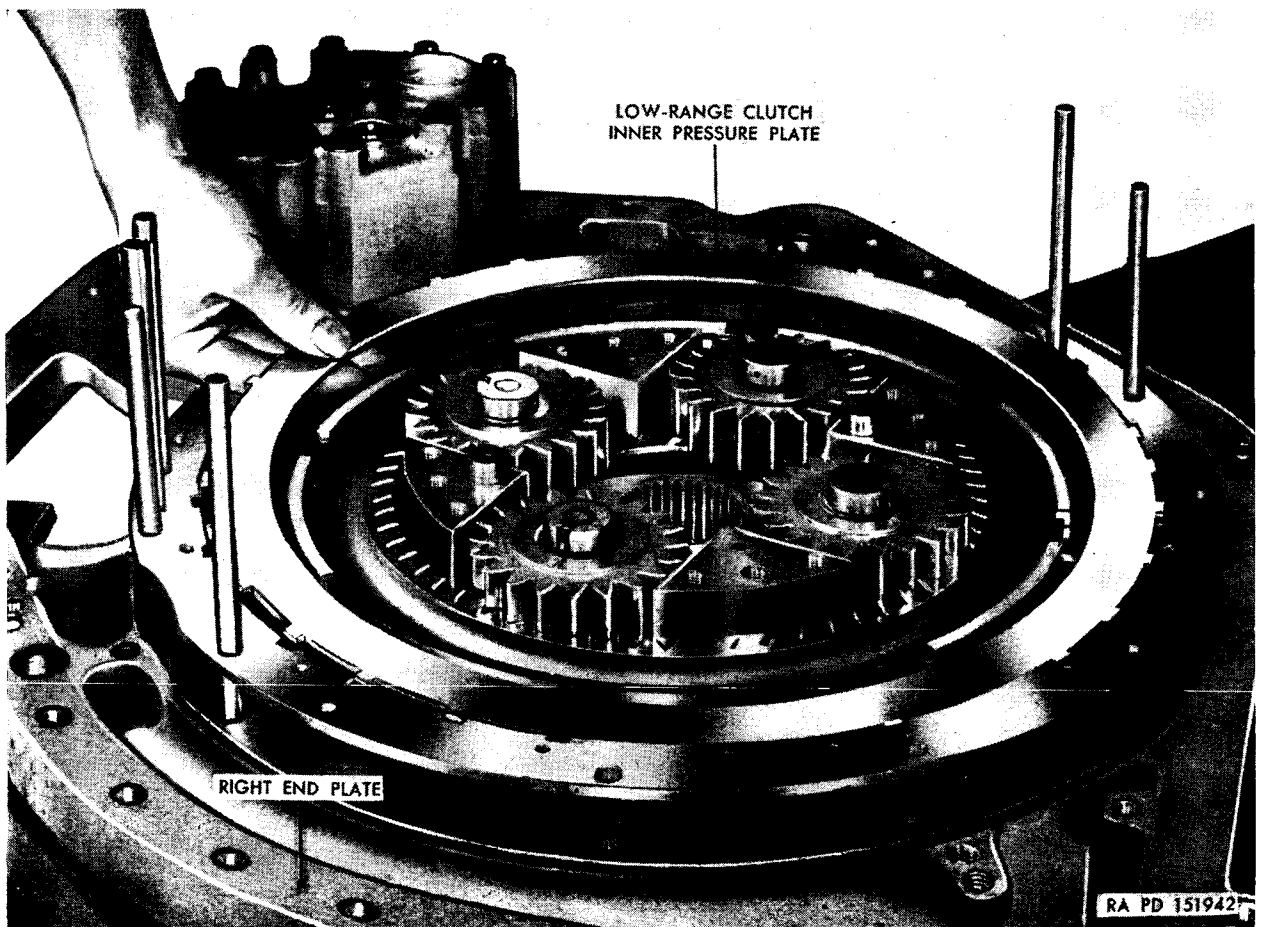


Figure 203. Removing or installing inner pressure plate.

installing the seal rings, make sure that the lip of the seal is toward the bore into which the piston fits.

e. **REVERSE-RANGE CLUTCH HUB.** Inspect the reverse-range clutch hub and bushing assemblies (fig. 208). If the bushing is defective, it may be pressed out with an arbor press, and a new one

may be pressed in. Stake the bushing in two places on each end and bore it to correct size.

f. **HIGH-RANGE HOUSING ASSEMBLY.**

- (1) Inspect the high-range housing assembly (fig. 209). Replace the two hook-type seal rings if they are defective. If it is necessary to disassemble this assembly, place it on an arbor press with the snap ring side up. Depress the spring retainer sufficiently to take the pressure off the snap ring. Using external snap ring

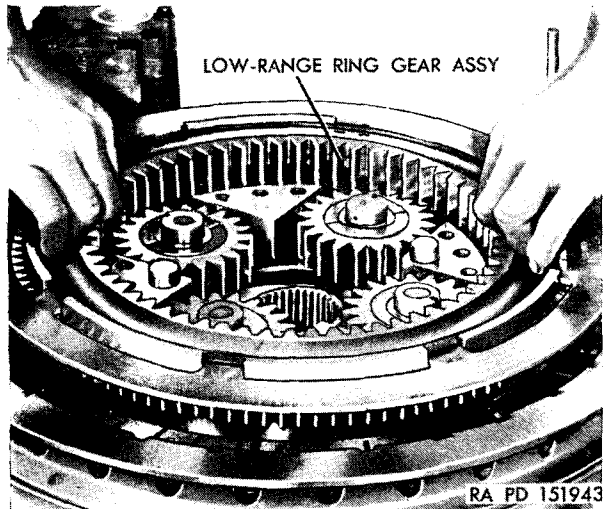


Figure 204. Removing or installing low-range ring gear assembly.

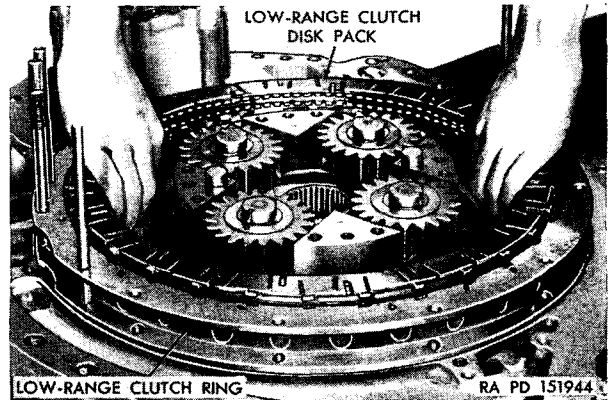


Figure 205. Removing low-range-clutch disk pack.

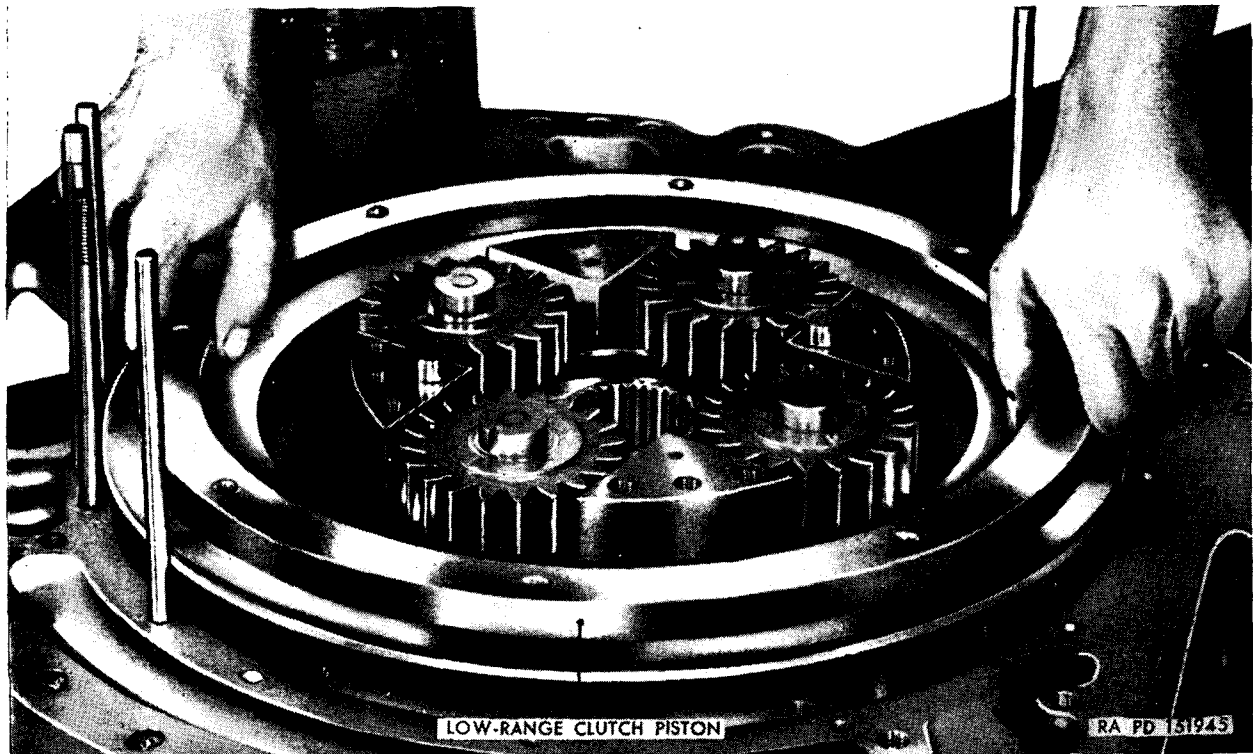


Figure 206. Removing or installing low-range-clutch piston.

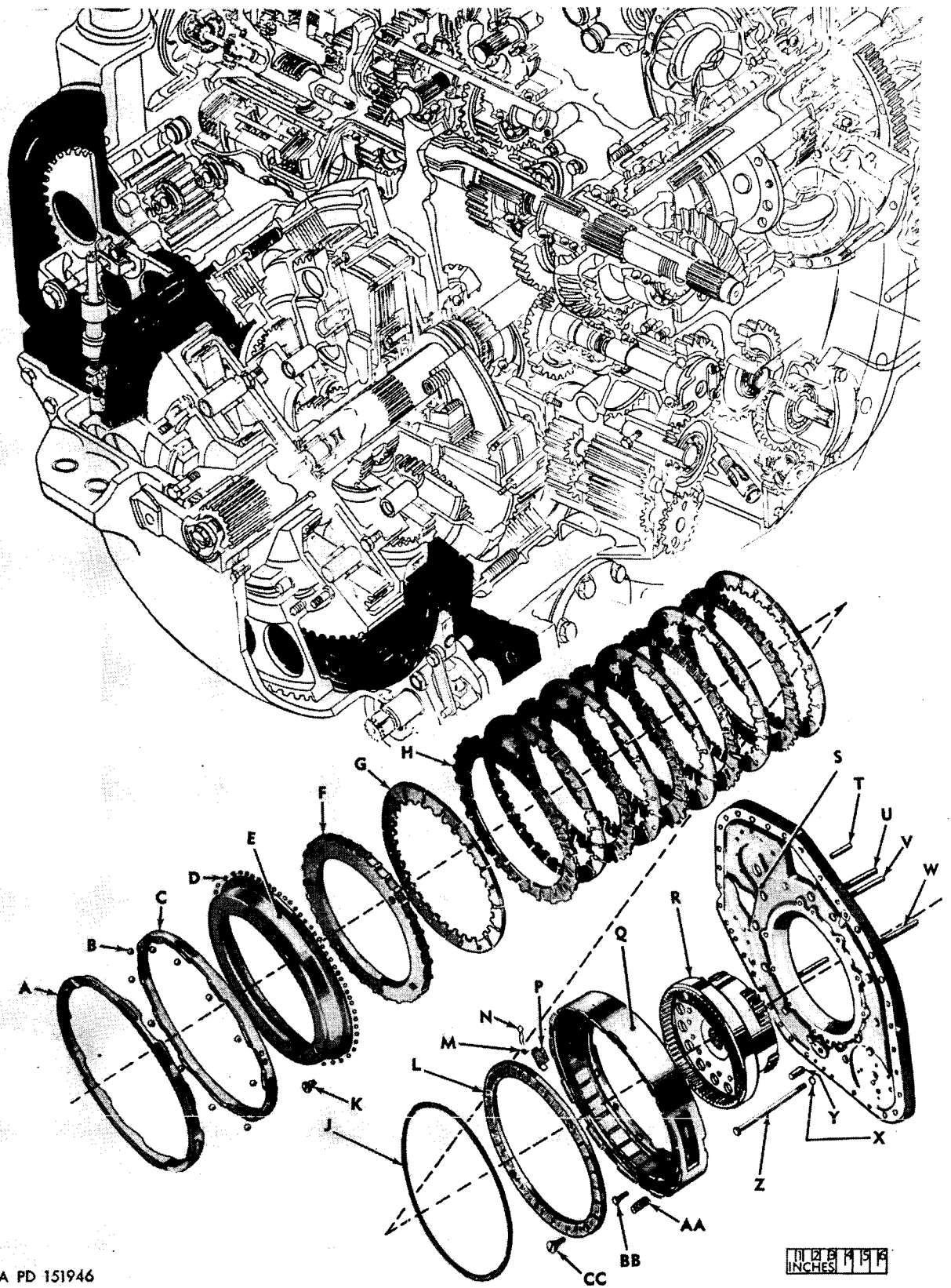
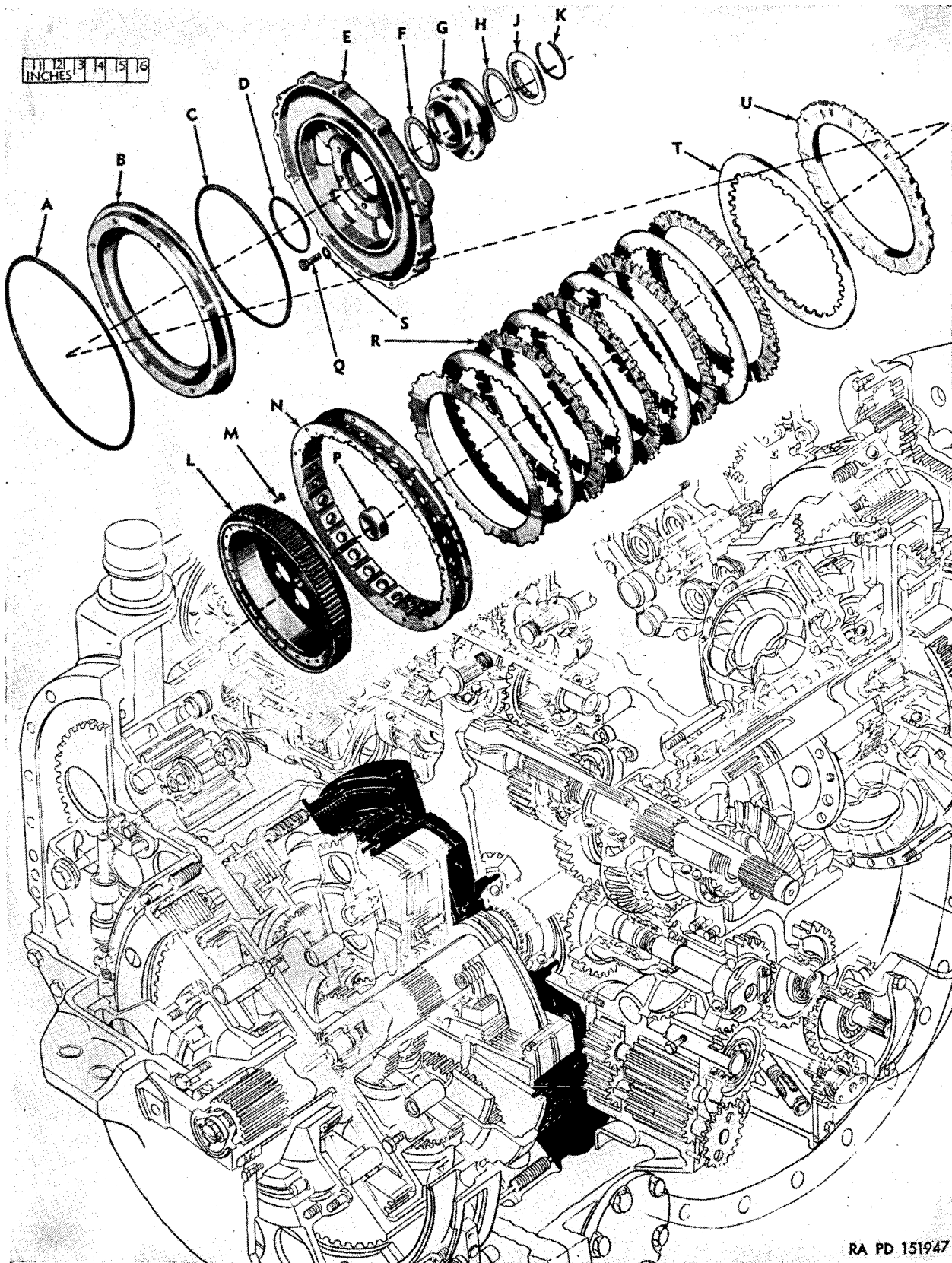


Figure 207. Right end plate, brake anchor, and brake disk assemblies—exploded view.

A—BRAKE APPLY CAM STATIONARY RING GM-6764066
 B—BALL (12) GM-145660
 C—BRAKE APPLY CAM ROTATING RING GM-6764068
 D—BALL (229) GM-145639
 E—BRAKE APPLY RING GM-6764004
 F—BRAKE FLOATING PRESSURE PLATE GM-6763956
 G—INTERNAL SPLINE DISK (6) GM-6765641
 H—EXTERNAL SPLINE DISK (5) GM-6763906
 J—SEAL RING GM-6765032
 K—BOLT (4) GM-6764803
 L—BRAKE FIXED PRESSURE PLATE GM-6704125
 M—SCREW (2) GM-6765471
 N—SAFETY WIRE GM-6704501
 P—INDICATOR GM-6765479
 Q—RIGHT BRAKE ANCHOR ASSEMBLY GM-6763998
 R—LOW-RANGE PLANET CARRIER ASSEMBLY AND OUTPUT RING GEAR
 S—END PLATE ASSEMBLY GM-6763919
 T—DOWEL GM-6704448
 U—TUBE GM-6760053 (REVERSE)
 V—TUBE GM-6765369 (HIGH TRANSFER)
 W—DOWEL (2) GM-6760043
 X—WASHER (12) GM-103341
 Y—DOWEL GM-6704448
 Z—BOLT (12) GM-6763741
 AA—BRAKE PLATE RELEASE SPRING (10) GM-8894407
 BB—BOLT (11) GM-192226
 CC—SCREW (2) GM-177945

Figure 207—Continued.



RA PD 151947

Figure 208. Reverse-range clutch assembly—exploded view.

A—OUTER LIP-TYPE SEAL RING GM-6765032
 B—REVERSE RANGE CLUTCH PISTON GM-6765449
 C—INNER LIP-TYPE SEAL RING GM-6704467
 D—SEAL RING GM-6763736
 E—REVERSE RANGE CLUTCH HOUSING ASSEMBLY GM-6763742
 F—THRUST WASHER GM-6763708
 G—HOUSING HUB GM-6763704
 H—THRUST WASHER GM-6763708
 J—SPLINED SPACER GM-6763703
 K—SNAP RING GM-6750064
 L—REVERSE RANGE CLUTCH HUB GM-6763707
 M—BOLT (24) GM-192099
 N—REVERSE RANGE CLUTCH RING GM-6763775
 P—BUSHING GM-6760063
 Q—BOLT (6) GM-221585
 R—REVERSE RANGE CLUTCH DOUBLE FACE DISK (BRONZE) (4) GM-6763906
 S—WASHER (6) GM-103340
 T—REVERSE RANGE CLUTCH DISK (STEEL) (5) GM-6704122
 U—SINGLE FACE DISK (BRONZE) (2) GM-6763898

Figure 208—Continued.

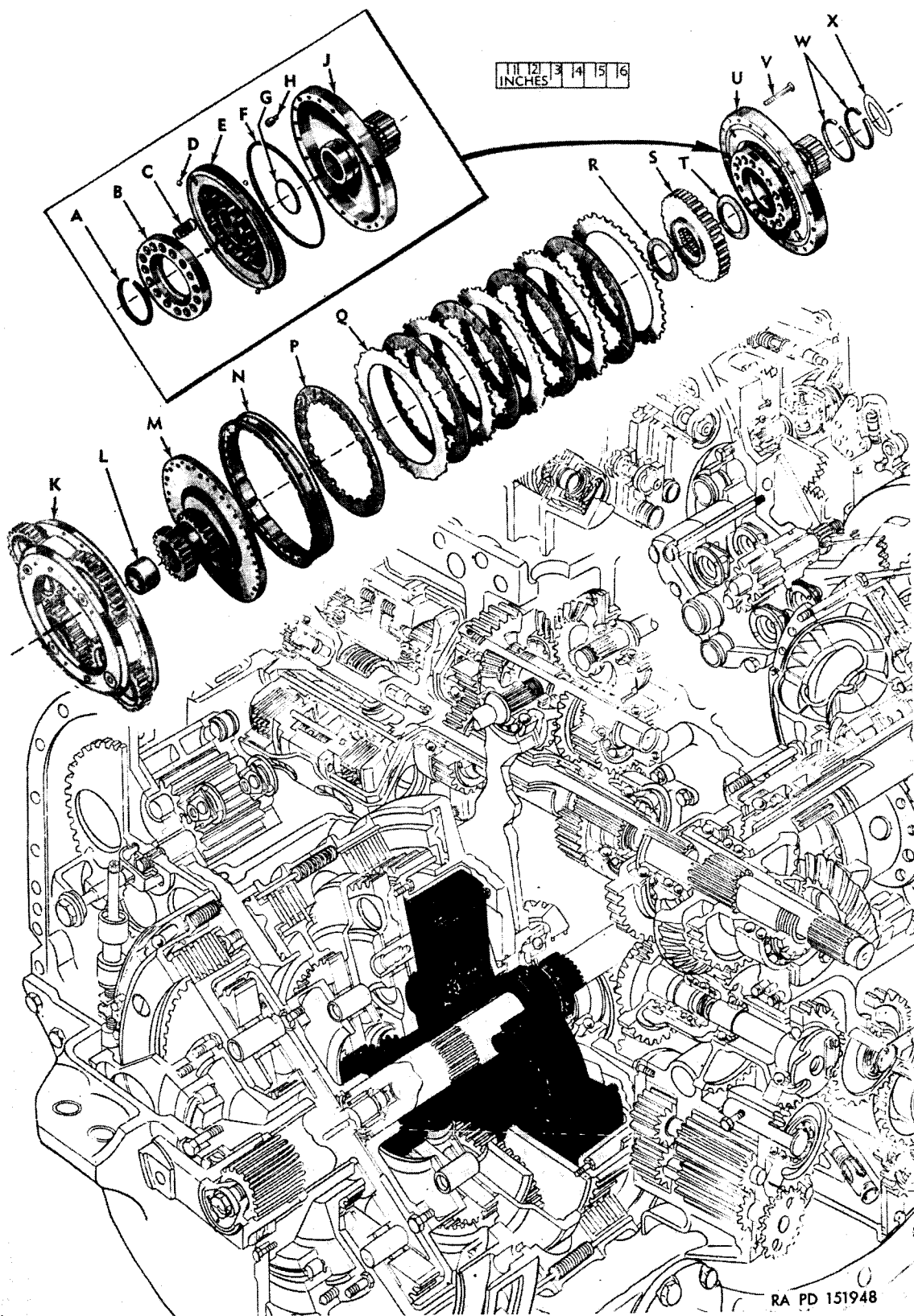


Figure 209. High-range clutch assembly—exploded view.

A—SNAP RING GM-6760072
 B—SPRING RETAINER GM-6765567
 C—PISTON RETURN SPRING (16) GM-6763922
 D—BALL (4) GM-145639
 E—HIGH RANGE CLUTCH PISTON ASSEMBLY GM-6765567
 F—LIP TYPE SEAL RING GM-6765572
 G—LIP TYPE SEAL RING GM-6765568
 H—DRIVE PIN (2) GM-6765521
 J—HIGH RANGE CLUTCH HOUSING GM-6763723
 K—REVERSE RANGE CARRIER ASSEMBLY GM-6764579
 L—BUSHING GM-6760066
 M—HIGH RANGE CLUTCH PINION GM-6763721
 N—HIGH RANGE CLUTCH OUTER DRIVE RING GM-6763797
 P—HIGH RANGE CLUTCH DISK (BRONZE) (5) GM-6765350
 Q—HIGH RANGE CLUTCH DISK (STEEL) (5) GM-6763841
 R—THRUST WASHER GM-6760060
 S—HIGH RANGE CLUTCH HUB GM-6765349
 T—THRUST WASHER GM-6760060
 U—HIGH RANGE CLUTCH HOUSING ASSEMBLY
 V—BOLT (20) GM-6763839
 W—HOOK TYPE SEAL RING GM-6765406
 X—THRUST WASHER GM-6763708

Figure 209—Continued.

pliers, remove the snap ring from the hub of the high-range housing.

- (2) Remove the spring retainer and the 16 piston-return springs. Remove the piston and inspect the lip-type seal ring. Inspect the lip-type seal ring on the housing hub. Replace any defective parts.
- (3) To assemble, install the seal ring on the housing hub with the lip toward the housing. Install the seal ring on the piston so that the lip will be toward the housing as the piston is installed in the housing.
- (4) Install the piston in the housing. Install the springs on the piston. Install the spring retainer, making sure that the springs are properly seated on the piston and in the retainer. Install the snap ring, using external snap ring pliers.

g. HIGH-RANGE CLUTCH PINION. Inspect the high-range clutch pinion (fig. 209). If the bushing is defective, it must be cut out. Install a new bushing using an arbor press.

h. CROSS-DRIVE SHAFT.

- (1) Inspect the cross-drive shaft and the needle bearing in each end of the shaft (fig. 143). If it is necessary to remove them, use a small chisel to cut through the staked places on the retainer. Remove the needle bearing and retainer, using an expanding-type remover or by using a small chisel.
- (2) To assemble, press the bearing and retainer into the cross-drive shaft. Stake the retainer to the shaft in six places.

i. REVERSE-RANGE PLANET CARRIER ASSEMBLY

- (1) Inspect the reverse-range planet carrier assembly (fig. 143). Rotate all four planet pinion gears. There should be no clatter or roughness during rotation. If disassembly is necessary, remove eight bolts, using a $\frac{3}{8}$ -inch wrench, from the planet-carrier plate. Using a brass drift and tapping lightly on the four spindles, separate the planet carrier from the planet-carrier plate (fig. 210).

Note. Be careful to identify each planet-pinion gear with its individual spindle. Each pinion gear must go back on the same spindle from which it was removed. Number each spindle and place corresponding numbers on separate containers for each planet pinion set. See figure 139.

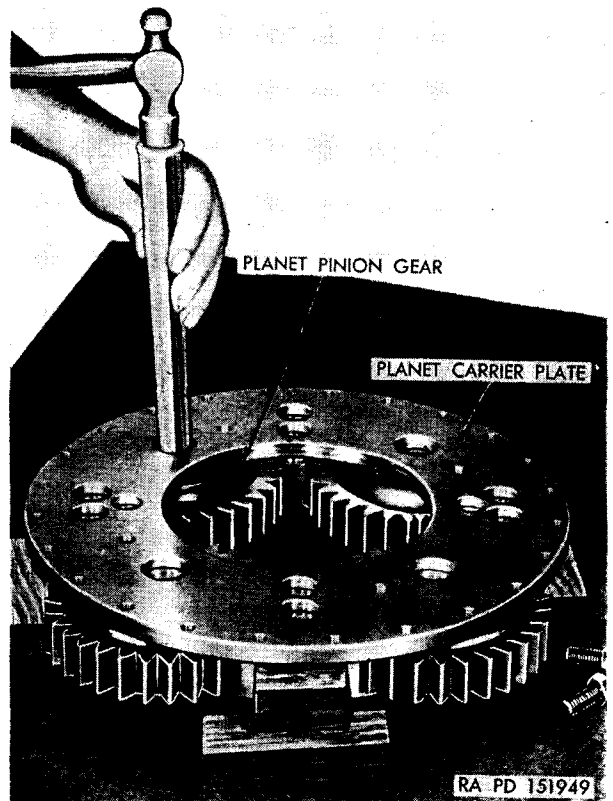


Figure 210. Separating planet carrier from plate.

- (2) Remove the thrust washer and the spacer from each of the four spindles on the planet carrier and place them in their proper containers. Remove the gear and the 22 roller bearings from each spindle and deposit them in their proper containers. Remove another thrust washer and another spacer from each spindle.

Note. Number each spindle bore in the planet carrier to correspond to the number on the spindle. Each spindle must go back into same bore from which it was removed.

- (3) Place the planet carrier in a vise equipped with soft jaws. Using long nosed pliers, remove the snap ring from each of the spindles (fig. 211). Using a hammer and a drift, drive out the pin which secures each spindle to the planet carrier (fig. 212).
- (4) Place the planet carrier on the assembly table and block it up with wood blocks so that the spindles may be driven out. Using a soft drift and a hammer, drive the spindles out of the planet carrier,

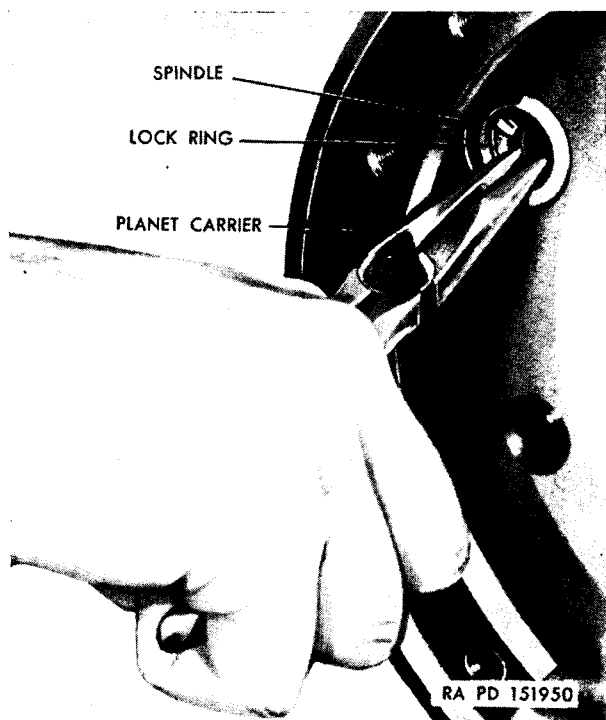


Figure 211. Removing or installing spindle snap ring.

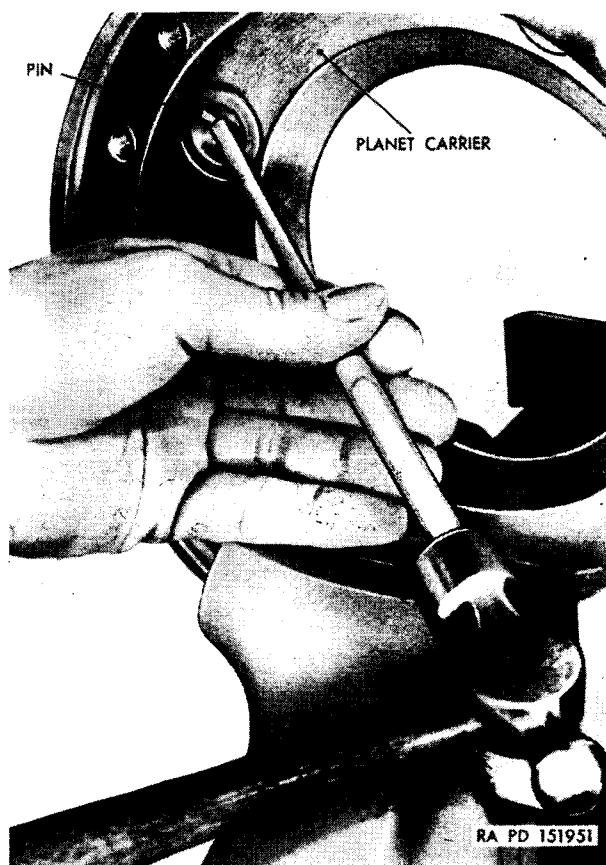


Figure 212. Removing spindle lock pin.

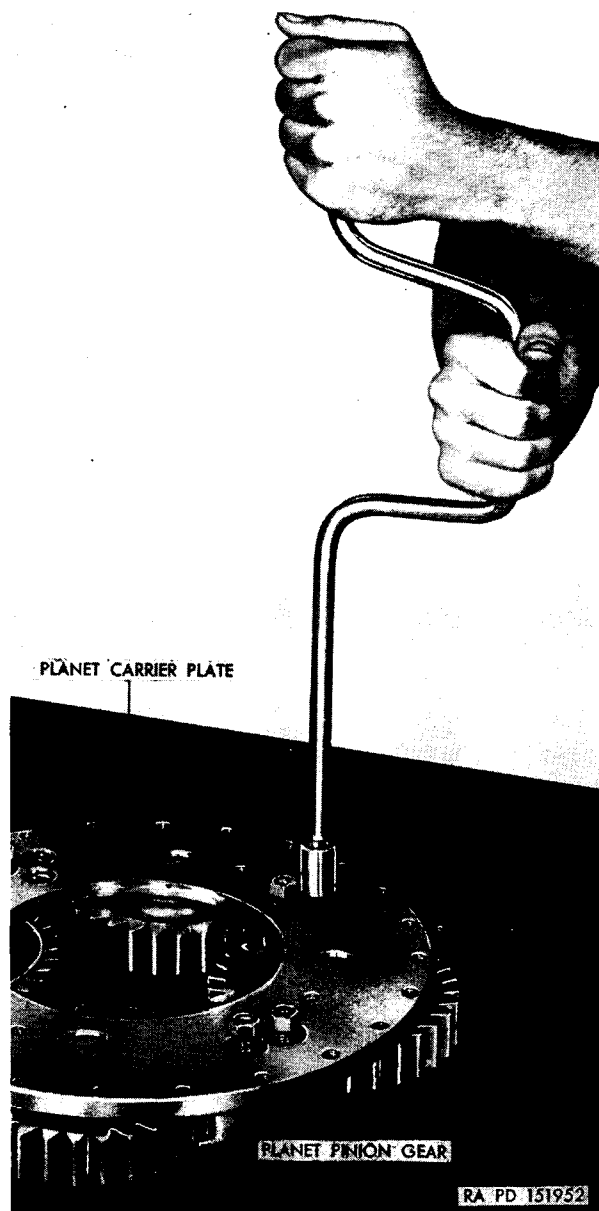


Figure 213. Installing planet-carrier plate.

being careful not to drive on the welsh plug in the end of the spindle.

- (5) Inspect the thrust washers and spacers for embedded foreign matter, wear, and heat discoloration. If they are defective, replace them. Inspect the pinion gears and the roller bearings.

Note. If it is necessary to replace one or more pinions, a matched set of four new pinions must be used.

Inspect the spindles for galling, scuffing, and heat discoloration. If these defects

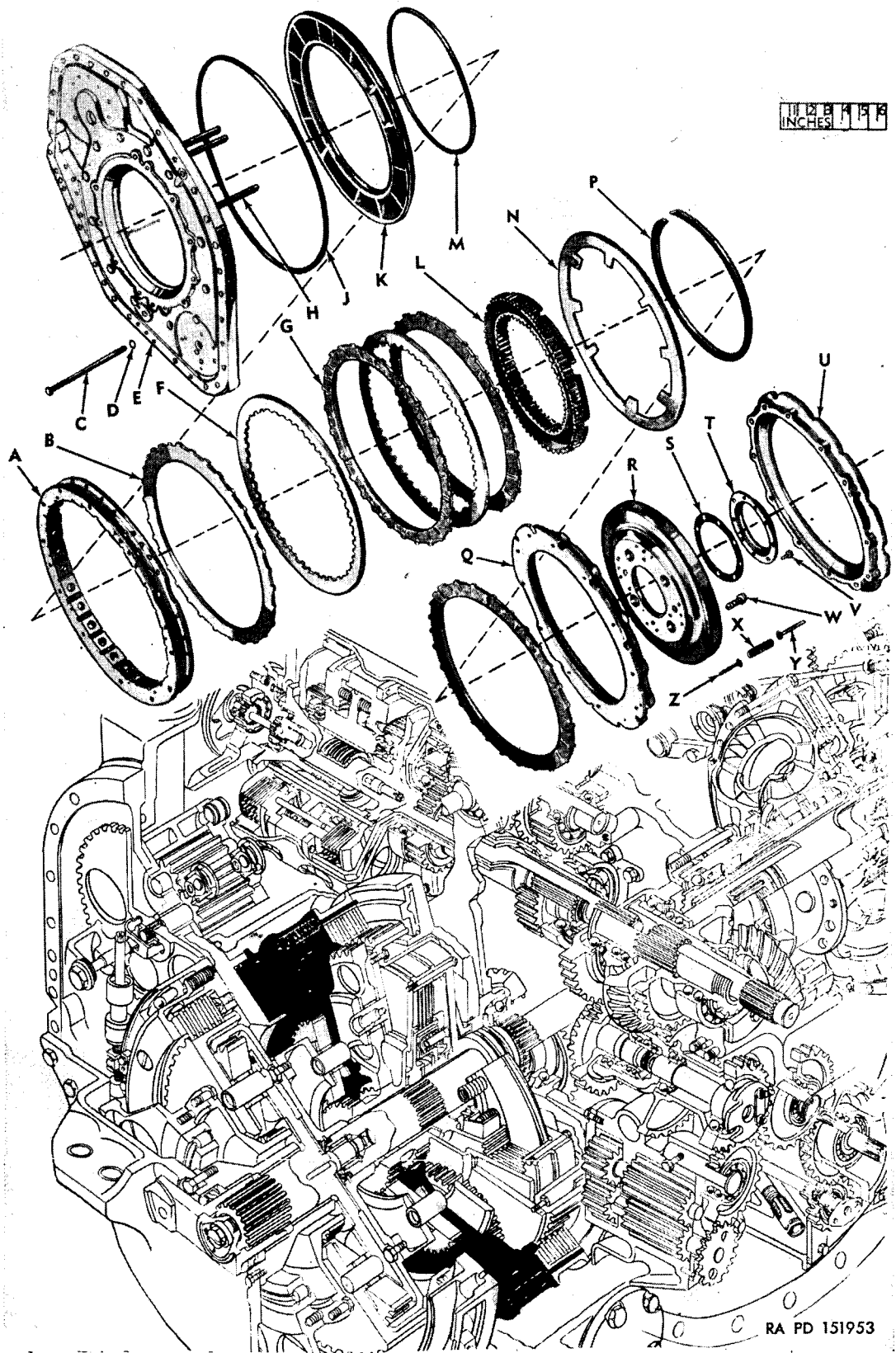


Figure 214. Low-range clutch assembly—exploded view.

A—LOW-RANGE CLUTCH RING GM-6763803
B—SINGLE FACED DISK (BRONZE) (2) GM-6763898
C—BOLT (12) GM-6763741
D—WASHER (12) GM-103341
E—RIGHT END PLATE GM-6763798
F—DISK (STEEL) (2) GM-6704122
G—DOUBLE FACED DISK (BRONZE) (2) GM-6763906
H—PACKAGE UNIT DOWEL (2) GM-6760043
J—SEAL RING GM-6765032
K—LOW RANGE CLUTCH PISTON GM-6765449
L—LOW RANGE RING GEAR GM-6760079
M—SEAL RING GM-6704467
N—LOW RANGE RING GEAR DISK GM-6760038
P—SNAP RING GM-6760035
Q—LOW RANGE CLUTCH BACK PLATE GM-6763767
R—REVERSE RANGE RING GEAR GM-6763718
S—GASKET GM-6763773
T—OIL RETAINING RING GM-6763732
U—REVERSE RANGE CLUTCH BACK PLATE GM-6763770
V—BOLT (8) GM-191590
W—PACKAGE UNIT BOLT (12) GM-192101
X—PISTON RETURN SPRING (12) GM-8605911
Y—PISTON RETURN PIN (12) GM-6760065
Z—PISTON RETURN PIN (12) GM-6760064

Figure 214—Continued.

cannot be removed with crocus cloth, replace the spindle.

- (6) If there is cause to believe that there is dirt inside the spindle, or if a welsh plug is defective, pry the welsh plug out of the spindle. Install a new plug in the spindle. Using an arbor press and a $\frac{1}{2}$ -inch diameter rod, press on the center of the plug to seat it in the spindle. Press the center of the plug down until it is almost even with the edges of the plug.
- (7) To assemble the reverse-range planet carrier assembly, press the four spindles into their respective bores in the planet carrier, plugged end first. Install a pin through the planet carrier into the pin hole of each spindle. Be sure that the snap ring groove in the pin is aligned with the snap ring groove in the spindle. Install a snap ring in each spindle (fig. 211). Install a thrust washer and spacer on each spindle. Install the four pinion gears on their spindles and install 22 roller bearings in each gear. Install another thrust washer and spacer on each spindle.
- (8) Install the planet-carrier plate on the planet-carrier dowels. Seat the plate on the planet carrier by tapping with a soft hammer. Install eight self-locking $\frac{1}{16}$ -inch bolts (fig. 213) and torque them 50 to 60 pound-feet.

j. REVERSE-RANGE RING GEAR ASSEMBLY. Inspect the reverse-range ring gear assembly (fig. 214). Inspect the oil retaining ring. If it is necessary to remove the oil retaining ring from the ring gear, remove the eight bolts from the retaining ring using a $\frac{1}{16}$ -inch wrench. Remove the oil retaining ring and gasket (fig. 215). Replace any defective parts. To assemble, install the gasket and oil retaining ring on the ring gear. Secure the ring to the gear with eight $\frac{1}{4}$ -inch bolts.

k. LOW-RANGE RING GEAR ASSEMBLY. Inspect the low-range ring gear assembly (fig. 214). If either the ring gear or the ring-gear disk is defective, use a screwdriver to remove the snap ring which retains the disk to the gear (fig. 216). Replace the defective part. To assemble, place the disk on the gear making sure that the "cone" of the disk is toward the snap ring, and install the snap ring.

l. LOW-RANGE CLUTCH PISTON. Inspect the

low-range-clutch piston and seal rings (fig. 214). Replace any defective parts. The seal rings must be installed on the piston so that the lip of the seal points toward the end plate as the piston is being installed.

m. RIGHT END PLATE. Inspect the right end plate (fig. 214). Inspect the dowels and the oil transfer tubes. Inspect the 12 long bolts to see if they are bent or have defective threads.

n. LOW-RANGE PLANET CARRIER AND OUTPUT-PLANETARY RING GEAR ASSEMBLY.

- (1) Inspect the low-range planet carrier and right output ring gear assembly (fig. 143). Rotate all four planet-pinion gears. There should be no clatter or roughness during rotation. If disassembly is necessary, refer to *i*(1) above. Begin with the note at the end of *i*(1) above and follow the procedure given in *i*(2) above.
- (2) If the output ring gear must be separated from the carrier, remove the 12 bolts, using a $\frac{3}{8}$ -inch wrench, from the output ring gear and lift it off (fig. 217). If the locating snap ring in the output ring gear is defective, remove it using two screwdrivers (fig. 218).
- (3) If the spindles must be removed from the low-range planet carrier, refer to *i*(3) through (8) above. If the spindles are not to be removed omit *i*(3), (4), and (6) above.

51. Assembly of Right End Plate and Drive Clutch Unit

a. OUTPUT SUMP PUMP.

- (1) Place the low-range planet carrier assembly on the assembly table so that it rests on the output ring gear.
- (2) Place the right end plate, oil transfer tubes up, over the low-range planet carrier assembly and on blocks 2 inches thick. Install two long package-unit bolts through the end plate bolt circle 180 degrees apart.
- (3) Install the output-sump pump on the end plate. Secure the pump to the end plate with eleven $\frac{1}{16}$ -inch bolts torqued 17 to 20 pound-feet.

b. LOW-RANGE CLUTCH PISTON.

- (1) Install the low-range-clutch piston in the end plate (fig. 206). Be careful not to roll the lip of the seal rings as the piston is inserted in the piston bore.

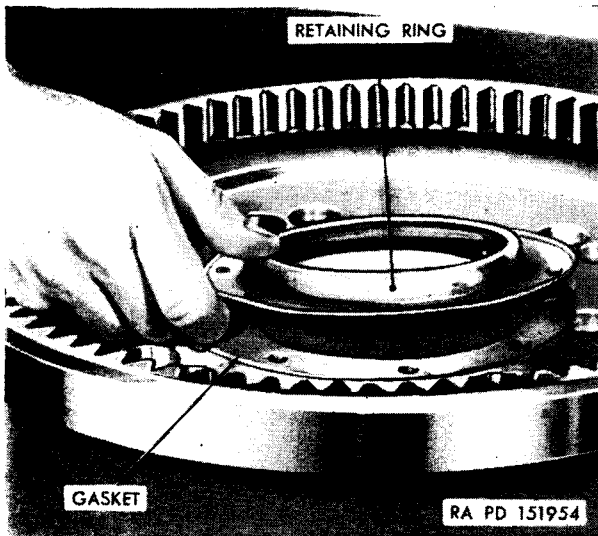


Figure 215. Removing or installing oil retaining ring.

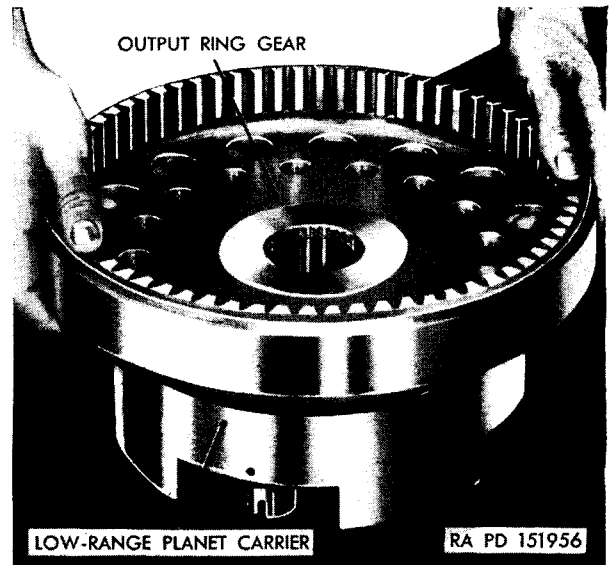


Figure 217. Removing output ring gear.

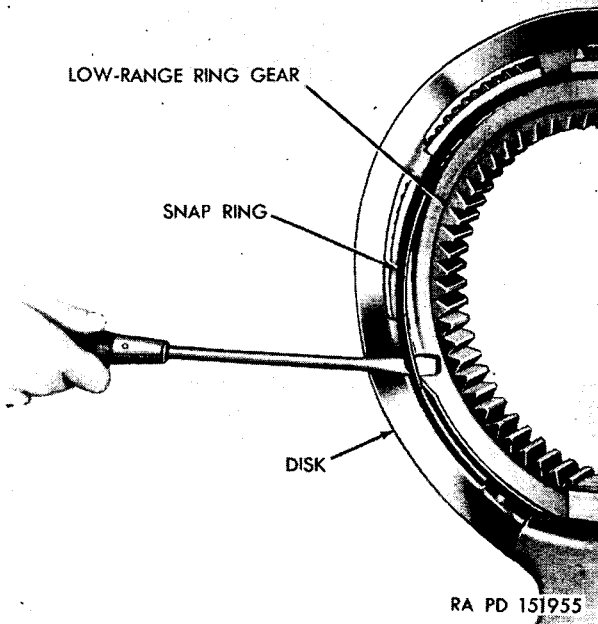


Figure 216. Removing ring-gear snap ring.

- (2) After the piston is installed, turn it in the bore. If the piston does not turn easily, it is probable that a lip of a seal ring has been turned up as the piston was installed. If this happens, remove the piston and inspect the seal rings. Replace the seal rings if they have been damaged. Reinstall the piston and check it as before.

c. LOW-RANGE CLUTCH.

- (1) Install the low-range-clutch ring (fig. 219).

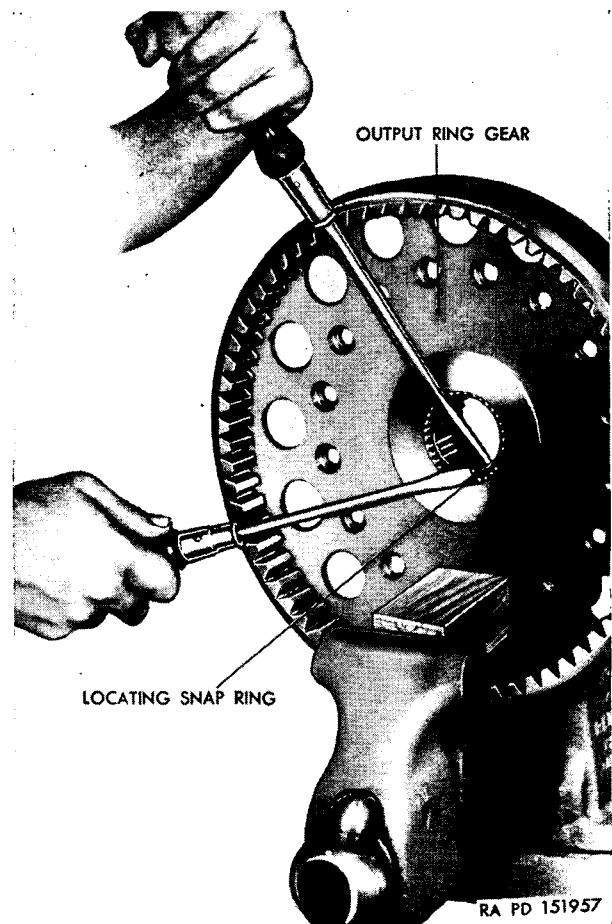


Figure 218. Removing locating snap ring.

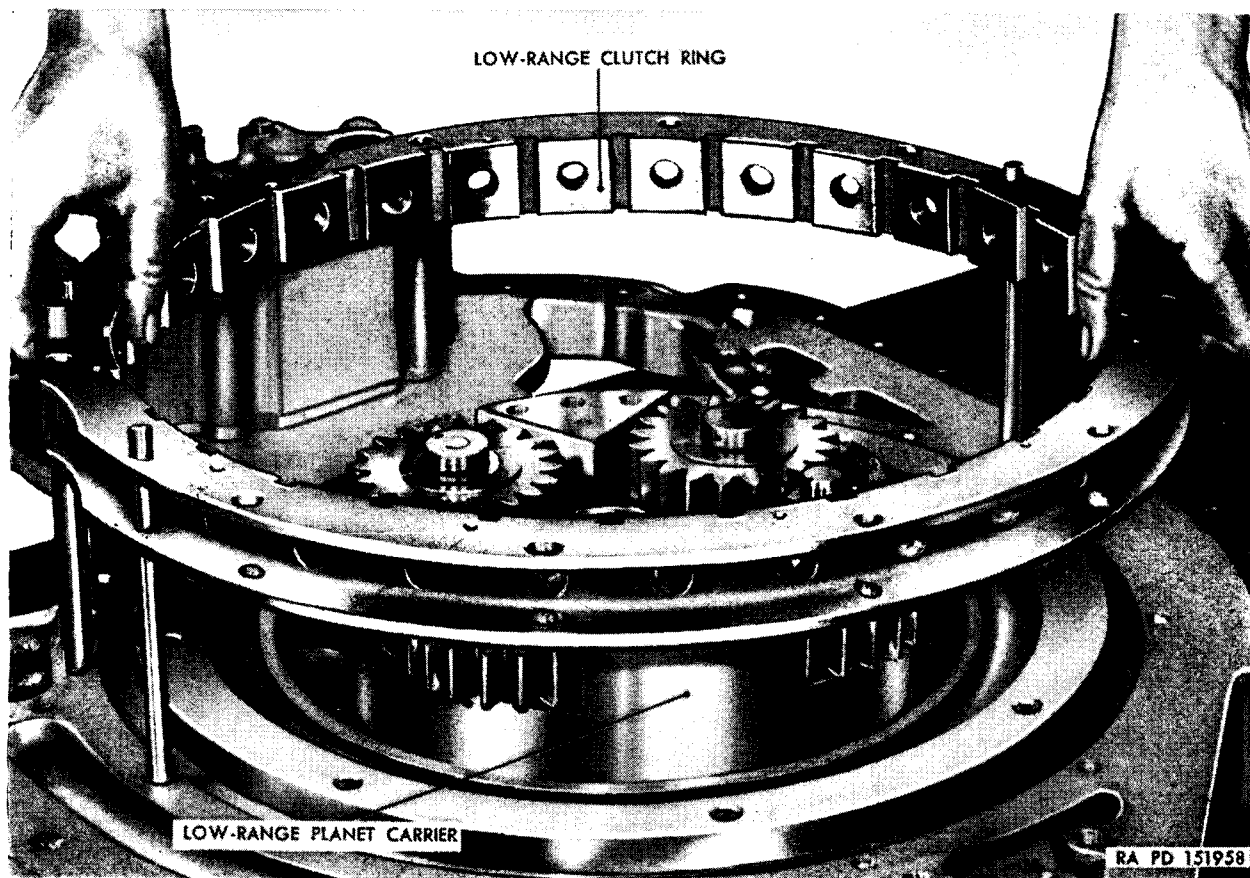


Figure 219. Installing low-range-clutch ring.

- (2) Install the single-faced bronze disk in the low-range-clutch ring so that the steel side of the disk is against the low-range-clutch piston. Install a steel disk, "cone" side up.

Note. All steel disks in the high-, low-, and reverse-range clutches must be installed "cone" side up.

Install a bronze disk, a steel disk, and another bronze disk.

- (3) Install the low-range ring gear and disk assembly, indexing it with the teeth of the planet pinions as well as the tabs on the steel disks (fig. 204). Install the other single-faced bronze disk with the bronze face toward the low range ring gear.

d. REVERSE-RANGE PLANETARY.

- (1) Install the low-range-clutch back plate (fig. 220).
- (2) Install the reverse-range ring gear on the low-range planet-carrier dowels, seating

it with a soft hammer. Install twelve $\frac{1}{16}$ -inch bolts through the ring gear to the planet carrier and torque 50 to 60 pound-feet.

- (3) Install the reverse-range planet carrier in the ring gear (fig. 201).
- (4) Install the 12 short piston-return pins in the low-range back plate. Install the 12 piston-return springs in the low-range back plate.
- (5) Place the reverse-range back plate on the package-unit dowels and install the 12 long piston-return pins between the back plate and the return springs.
- (6) Push the reverse-range back plate down over the pins and springs (fig. 199). Install the two screws which secure the back plates together.

e. HIGH-RANGE CLUTCH.

- (1) Install the high-range clutch pinion rotating it to engage the teeth of both sets of planet-pinion gears (fig. 221).

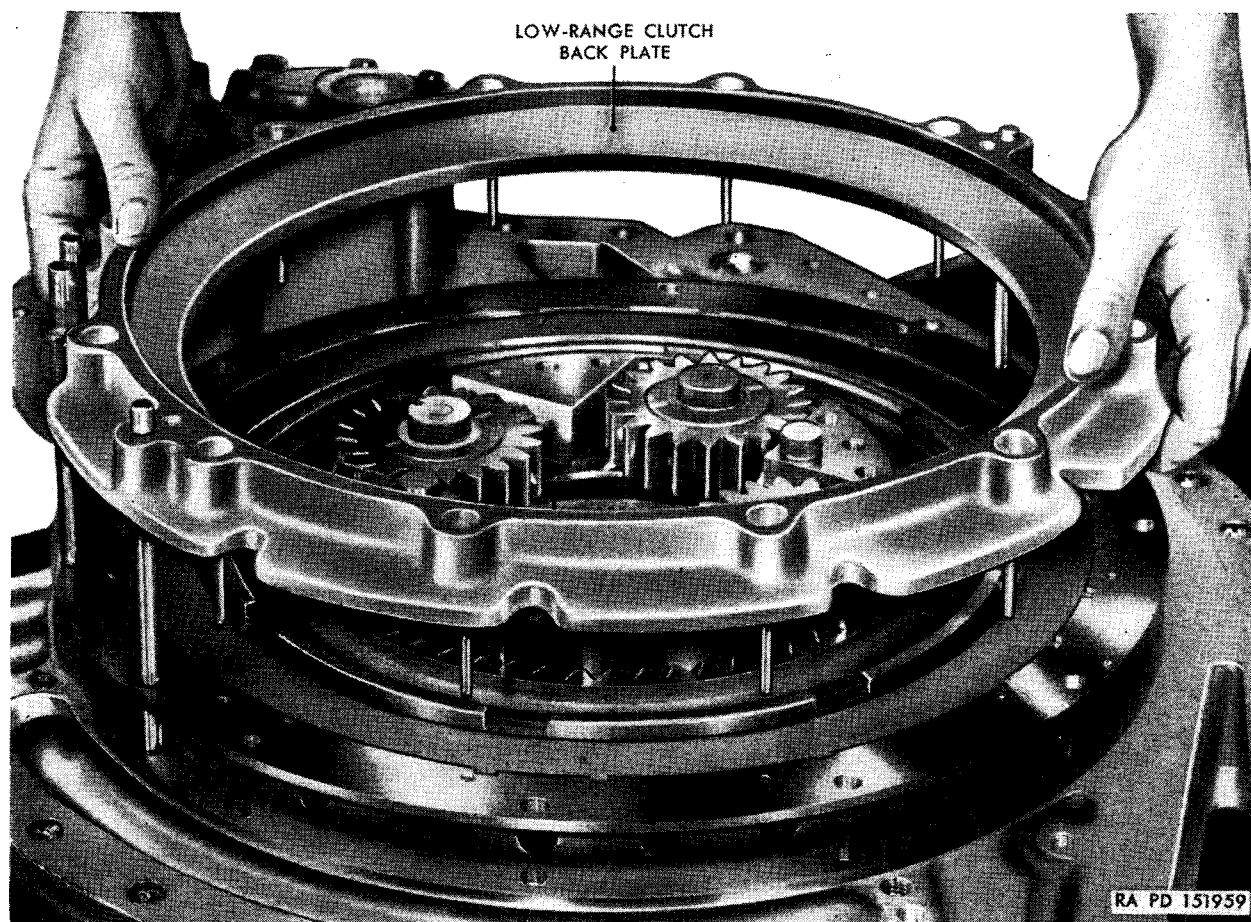


Figure 220. Installing low-range-clutch back plate.

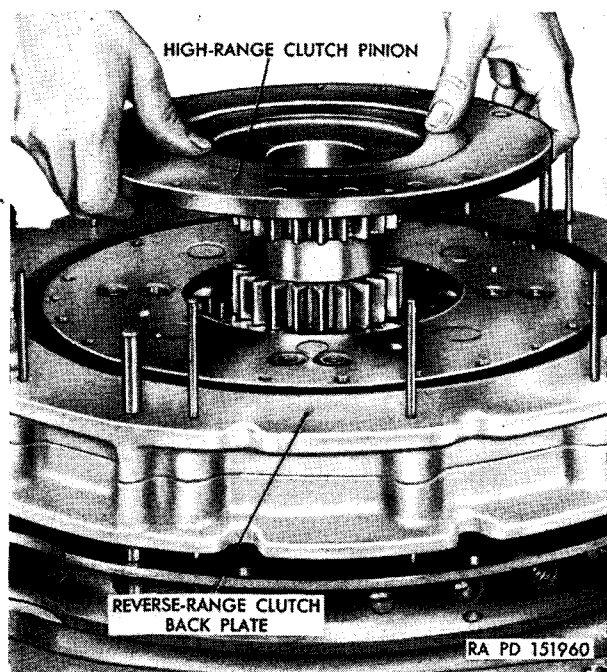


Figure 221. Installing high-range-clutch pinion.

- (2) Install the cross-drive shaft making sure the bottom splines on the shaft are engaged with the splines in the output-planetary ring gear (fig. 198).
- (3) Install the high-range-clutch-outer-drive ring on the high-range pinion, being careful to align the bolt holes.
- (4) Install one thrust washer on each side of the high-range-clutch hub, using hard grease so that the washers will stick to the hub. Install the high range clutch hub, flat side down, over the cross-drive shaft (fig. 196).
- (5) Install alternately the five bronze and five steel high-range clutch disks, starting with a bronze disk, and ending with a steel disk.

Note. The steel disks must be installed "cone" up.
- (6) Install the high-range housing assembly on the outer-drive ring, being careful to

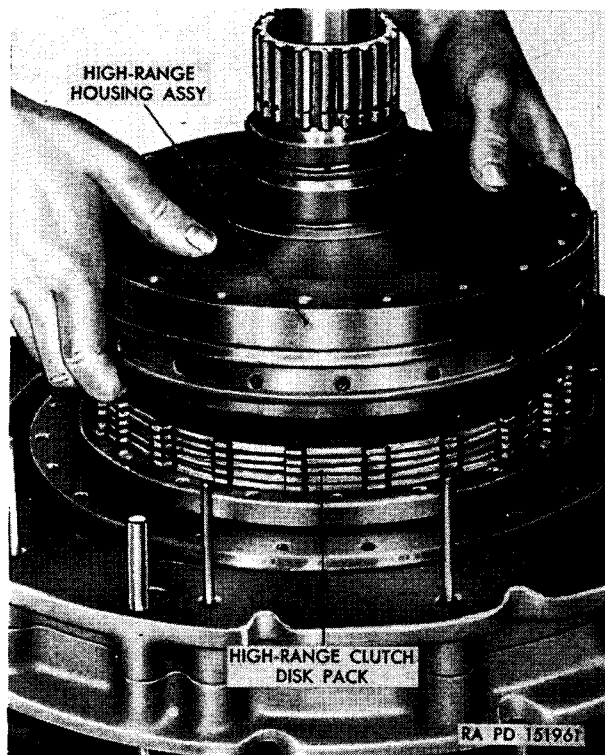


Figure 222. Installing high-range housing assembly.

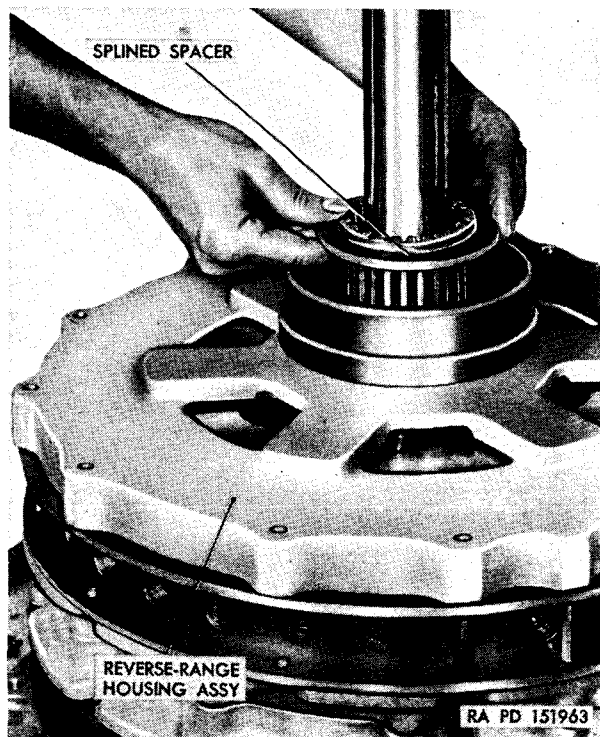


Figure 224. Installing splined spacer.

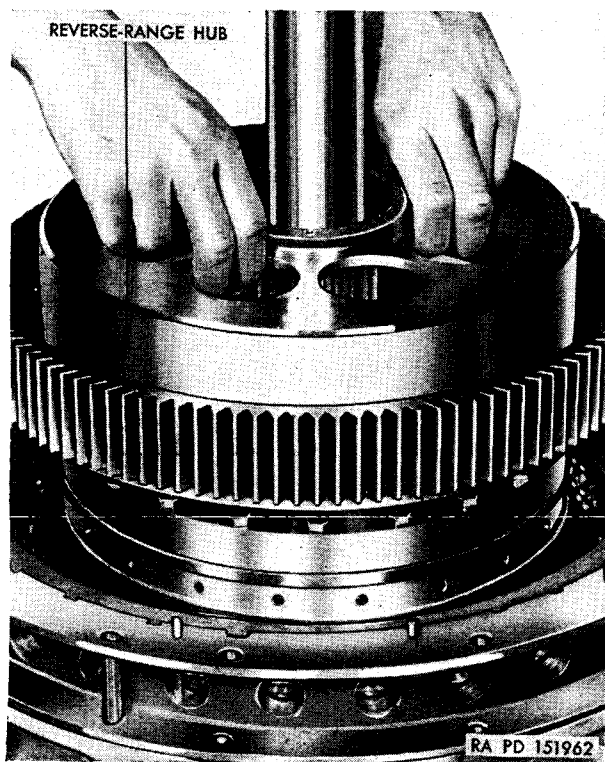


Figure 223. Installing reverse-range hub.

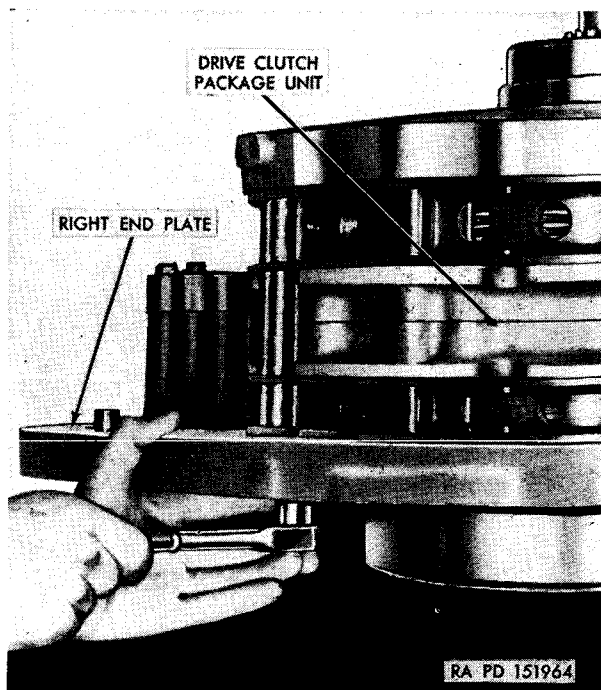


Figure 225. Installing package unit bolts.

aline the bolt holes (fig. 222). Install twenty $\frac{5}{16}$ -inch bolts through the housing, the outer-drive ring, and into the high-range pinion.

f. REVERSE-RANGE CLUTCH.

- (1) Install a thrust washer over the hub of the high-range housing. Install the reverse-range ring, seating it with a soft hammer.
- (2) Install the reverse-range hub, being careful to aline the bolt holes (fig. 223). Seat the hub on the reverse-planet carrier by tapping with a soft hammer. Install twenty-four $\frac{5}{16}$ -inch bolts in the hub.
- (3) Install a single-face-bronze reverse-range clutch disk with the bronze side up. Install five steel disks and four bronze disks alternately, beginning and ending with a steel disk. Install a single-face-bronze disk with the steel side up.
- (4) Install the reverse-range piston in the reverse-range housing assembly ((2)b above).
- (5) Install a thrust washer on each side of the housing hub, using hard grease on the washers so that they will stick to the housing. Install the housing on the reverse-range ring, being careful to see that the dowels and oil transfer tubes enter their bores in the housing. Be careful not to allow the piston to drop out of the housing. Seat the housing by tapping on it with a soft hammer.
- (6) Turn the two package-unit bolts into the threads in the reverse-range housing. Tighten the bolts evenly.
- (7) Install the splined spacer, flat side down, on the reverse-range housing hub (fig. 224). Using external snap ring pliers, install the snap ring (fig. 189).

g. PACKAGE UNIT END PLAY.

- (1) Set the assembly on the output-ring gear. Make sure that the ring gear is level. Level the end plate.
- (2) Using a parallel bar and a depth micrometer, measure and record the distance from the top of the high-range-clutch-housing hub to the top of the reverse-range-clutch-housing hub. It is best to make the measurement in several places and then obtain the average reading.
- (3) After measuring, block up the end plate

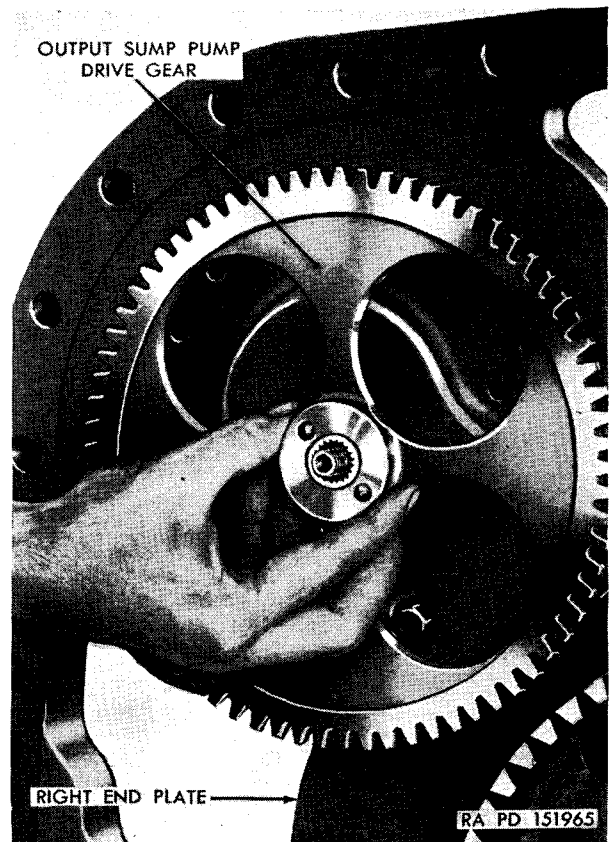


Figure 226. Installing output-sump-pump drive gear.

so that the ring gear does not touch the assembly table. Level the end plate.

- (4) Again measure and record the distance between the two hubs. Take measurements at several points on the hubs and then determine the average measurement.
- (5) Subtract the last average measurement from the first average measurement. The result will be the end play between the reverse-range-clutch housing and the high-range-clutch housing. The end play should be between 0.009 and 0.040 inch.
- (6) If the end play exceeds these limits, disassemble the package unit and inspect it for improper assembly and for parts which are not the right size.

h. RIGHT-END PLATE AND DRIVE CLUTCH UNIT ASSEMBLY. Using a hoist, lift the assembly and lower it so that the bottom of the end plate rests on the assembly table. Install the remaining ten $\frac{5}{16}$ -inch package unit bolts. Make them snug but do not torque until the package unit has been installed in the right housing. Install the output-

sump-pump drive gear on the pump shaft (fig. 226). Install the gear retaining nut and torque to 30 pound-feet. Install the speedometer-drive coupling on the output-sump-pump drive gear.

Note. It is easier to assemble the right brake on the end plate after the end plate is installed in the transmission housings. The right brake assembly procedure will be found in paragraph 89c.

Section X. REBUILD OF CONTROL VALVE BODIES

A—BOLT (4) GM-446565
B—RANGE SELECTOR VALVE COVER GM-6764119
C—GASKET GM-6760111
D—RANGE SELECTOR VALVE GM-6760107
E—PLUG GM-6765543
F—"O" RING GASKET GM-6762127
G—OVERSPEED SAFETY VALVE GM-6765436
H—VALVE SLEEVE GM-6764143
J—SPRING GM-6765419
K—BOLT (3) GM-192353
L—WASHER (18) GM-103341
M—BOLT (6) GM-221599
N—VALVE SLEEVE GM-6765544
P—PIPE PLUG GM-444693
Q—BOLT (3) GM-187234
R—BOLT (1) GM-186309
S—SHIFT LEVER POPPET GM-6700687
T—POPPET SPRING GM-6704182
U—RANGE SELECTOR SHAFT OIL SEAL GM-6700686
V—THRUST WASHER GM-8894389
W—SELECTOR INDICATOR GM-6765476
X—COPPER GASKET GM-6702388
Y—RANGE SELECTOR DETENT PLUG GM-6764123
Z—SNAP RING GM-6701304
AA—SPRING GM-6764517
BB—VALVE GUIDE GM-6764115
CC—SNAP RING GM-6703424
DD—VALVE-BODY-TO-CONVERTER-OIL-FILTER GASKET GM-6760165
EE—LUBRICATING OIL REGULATOR PLUG GM-6764114
FF—"O" RING GASKET GM-6760995
GG—VALVE GUIDE GM-6764116
HH—VALVE SPRING GM-6764516
JJ—COOLER BY-PASS VALVE GM-6764117
KK—VALVE SEAT GM-6764118
LL—LUBRICATING OIL REGULATOR VALVE GM-6764117
MM—VALVE SEAT GM-6764118
NN—VALVE SLEEVE GM-6764138
PP—PIPE PLUG (7) GM-444689
QQ—RANGE CONTROL VALVE BODY GM-6765560
RR—SHIFT VALVE INNER LEVER ASSEMBLY GM-6760051
SS—VALVE-BODY-TO-HOUSING GASKET GM-6765453
TT—PIPE PLUG (1) GM-444689
UU—VALVE SLEEVE GM-6764136
VV—MAIN OIL REGULATOR VALVE GM-6760114
WW—SPRING GM-6764513
XX—"O" RING GASKET GM-6765182
YY—MAIN OIL REGULATOR VALVE PLUG GM-6765541
ZZ—CONVERTER REGULATOR VALVE GM-6764135
AB—SPRING GM-6765451
AC—"O" RING GASKET GM-6763500
AD—CONVERTER REGULATOR PLUG GM-6765160

Figure 227. Range-control valve body assembly—exploded view.

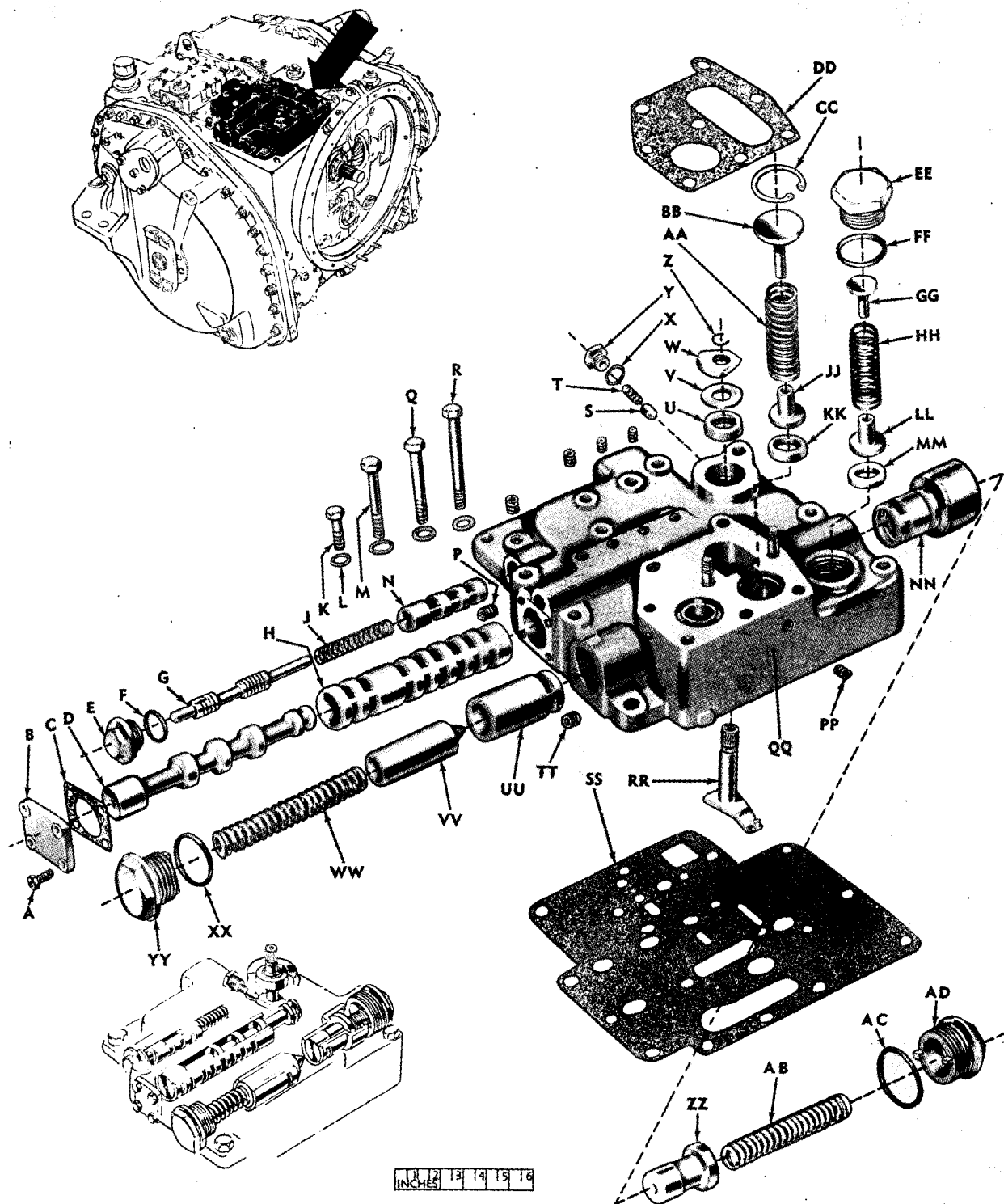


Figure 227—Continued.

RA PD 151966

52. Disassembly of Control Valve Bodies

a. DISASSEMBLY OF RANGE CONTROL VALVE BODY (fig. 227).

- (1) Using a $\frac{3}{8}$ -inch wrench, remove the range-selector-detent plug (Y) and copper gasket (X). Lift out the poppet spring (T) and shift lever poppet (S).
- (2) Using snap ring pliers (41-P-1992-35), remove the snap ring (CC) which holds the cooler-by-pass valve in the valve body assembly (fig. 228). Lift out the valve guide (BB), spring (AA), and cooler-by-pass valve (JJ).
- (3) With snap ring pliers, remove the snap ring (Z) on the shift-valve-inner lever assembly (RR). Using a soft hammer, gently tap the shaft out of the selector indicator (W), thrust washer (V), range selector shaft oil seal (U), and range control valve body (QQ).
- (4) Using a $\frac{3}{8}$ -inch wrench, remove the plug (E) and the "O" ring gasket (F) which covers the overspeed-safety valve (G). Lift out the valve and spring (J).
- (5) Remove four bolts (A) from the range-selector-valve cover (B) using a $\frac{1}{2}$ -inch wrench. Lift off the cover and gasket (C). Slide the range selector valve (D) out of the valve sleeve (H).
- (6) Using a $1\frac{1}{8}$ -inch wrench, remove the main-oil-regulator-valve plug (YY) and "O" ring gasket (XX). Lift out the spring (WW) and main-regulator valve (VV).
- (7) With a $1\frac{1}{8}$ -inch wrench, remove the converter-regulator plug (AD) and "O" ring gasket (AC) from the body. Remove the spring (AB). Lift out the converter-regulator valve (ZZ).
- (8) Using a $1\frac{1}{8}$ -inch wrench, remove the lubricating-oil-regulator plug (EE) and "O" ring gasket (FF). Lift out the valve guide (GG), valve spring (HH), and lubricating-oil-regulator valve (LL).

b. DISASSEMBLY OF STEERING VALVE BODY (fig. 229).

- (1) With snap ring pliers, remove the snap-ring (L) holding the steering-lever shaft (FF). Remove the shift lever poppet plug (A) and gasket (GG), using a $\frac{3}{4}$ -inch wrench. Lift out the shift detent spring (C) and detent ball (F).

- (2) Using a soft hammer, gently tap the steering-lever shaft (FF) through the indicator (K), thrust washer (J), steering shaft oil seal (H), and steering valve body (G). Remove the two steering valve plugs (W and V) and annular gaskets (U and X) from the valve body, using a $1\frac{1}{4}$ -inch wrench. Lift out the right- and left-steering valve assemblies (Q, R, S, and T) (BB, AA, Z, and Y).

Note. Do not disturb the spring adjustment on the steering valves, unless it has been previously determined that there was a malfunction caused from maladjustment of the valves.

53. Cleaning

Refer to paragraph 25 for cleaning instructions.

54. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for general inspection and repair procedure. Refer to paragraph 101 for serviceability measurements and wear limits.

b. RANGE CONTROL VALVE BODY (fig. 227).

- (1) Inspect the valves for burs and scratches and if found remove them with crocus cloth or a soft stone. Inspect all springs for proper length and tension. Inspect valve seats (KK and MM) and valve sleeves (H, N, NN, and UU) for burs, scratches and looseness. If these defects are found and cannot be removed with crocus cloth or a soft stone, replace the valve body assembly.
- (2) Do not remove any of the pipe plugs (PP) from the valve body unless they are defective. If the range-selector-shaft oil seal (U) is defective, remove it and install a new seal, using replacer (41-R-2392-72) and handle (41-H-1396-505) (fig. 230).
- (3) Inspect the valve body to housing gasket (SS), valve body to converter oil filter gasket (DD) and the "O" ring gaskets and annular gaskets for cracks, tears, and hardness. Replace if defective.

c. STEERING VALVE BODY (fig. 229).

- (1) Inspect the steering valve body.

Note. Do not remove the two hex-head screws (B and EE) and the washers (D and DD) from the valve body because these bolts are stops for the steering valves.

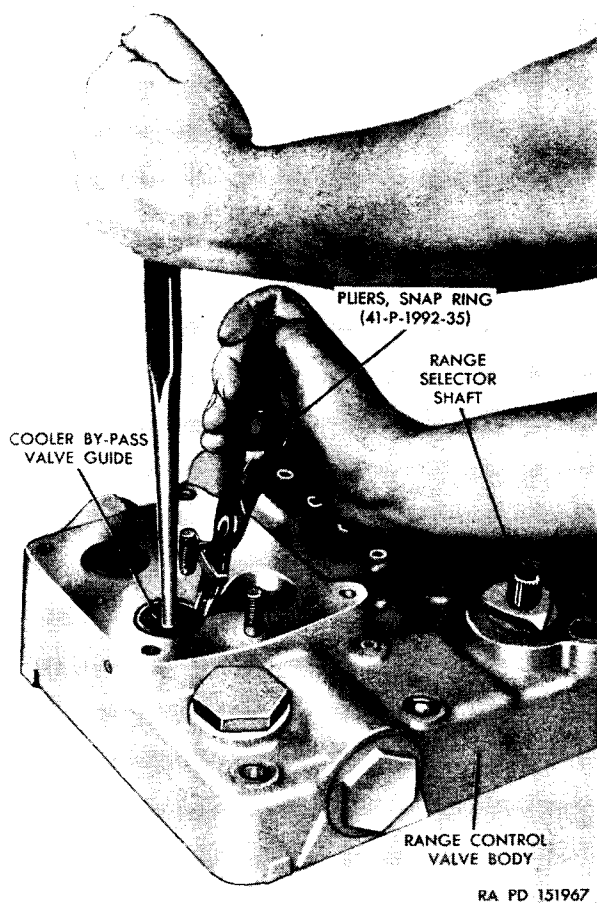


Figure 228. Removing cooler-by-pass-valve snap ring.

Do not remove the pipe plugs (M) from the steering-clutch pressure-check points unless they are defective.

- (2) If the steering-shaft oil seal (H) is defective, remove it. Install a new seal using replacer (41-R-2392-72) and handle (41-H-1396-505). If there are any defective steering valve parts remove the nut (Q or BB) from the end of the right or left steering valve (T or Y) and replace the defective parts.

Note. Do not crimp the nut to the end of the steering valve at this time. The valve must be adjusted after it is installed in the valve body.

Inspect the valve body to plate gasket (HH) and the plate to housing gasket (MM) for cracks, tears, and hardness. Replace all defective parts.

d. ADJUSTMENTS OF STEERING VALVE BODY (fig. 229).

- (1) If the steering valves have been disas-

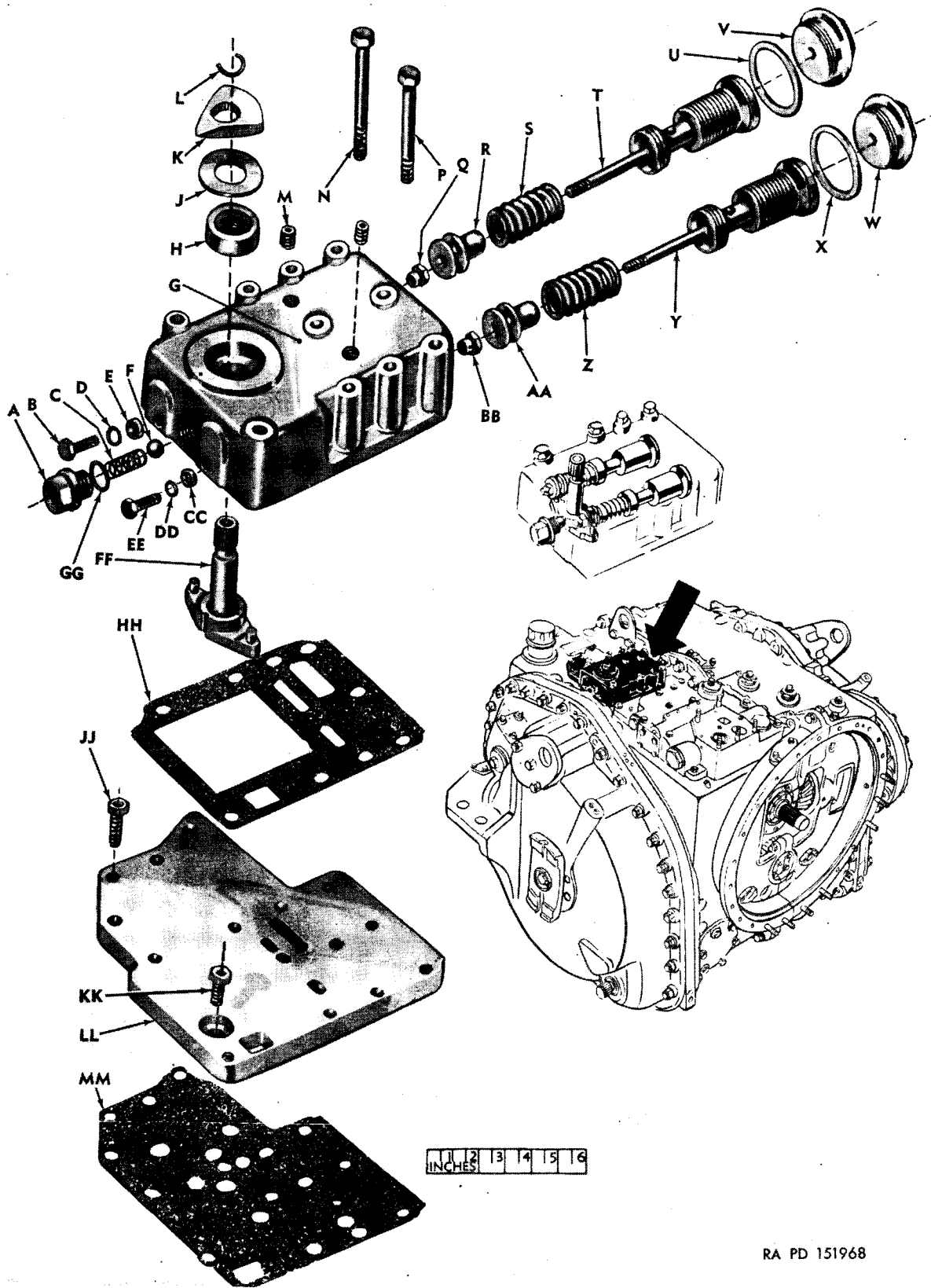
sembled or if a new valve body or steering-valve lever assembly has been installed, it is necessary to make a new neutral position adjustment of the valves. After assembly of the valve body, place it bottom side up, on blocks, on the assembly table so that the steering lever shaft (FF) is not resting on the assembly table.

- (2) With the steering lever shaft (FF) in neutral position, tighten or loosen the nut (Q or BB) on the end of each valve until there is 0.060- to 0.070-inch clearance between the valve land nearest the spring (S or Z) and the shoulder in the valve body.
- (3) This distance can be measured by inserting a feeler gage between the side of the valve land which is against the spring and the machined surface on the shoulder at the edge of the valve bore.

Note. The clearance must be measured at both valves simultaneously.

Secure the nut to the valve stem by squeezing the small diameter of the nut into the flats on the valve stem.

- (4) If the steering-valve body or the steering lever shaft assembly (FF) has been replaced, the steering valves (T and Y) must be adjusted to open the proper amount. This adjustment will also have to be made if the washer (D or DD) on the hex-head screw (B or EE) have been misplaced.
- (5) With the steering-valve plugs (W and V) removed from the valve body, move the right-steering valve (T) in until the steering lever shaft (FF) is against the hex-head screw (B). Using a depth micrometer, measure and record the distance from the right-valve-plug mounting face on the valve body to the face of the right steering valve (T) nearest the plug opening.
- (6) If this measurement is greater than 0.547 inch, subtract 0.547 inch from the measurement. The result will be the thickness of the shim washers (D) to be removed from the screw-stop shim pack. If the measurement is less than 0.547 inch, subtract the measurement from 0.547 inch. The result will be the thickness of the shim washers (D) to be added



RA PD 151968

Figure 229. Steering valve body assembly—exploded view.

A—SHIFT LEVER POPPET PLUG GM-6760036
 B—HEX-HEAD SCREW GM-6765625
 C—STEERING LEVER DETENT SPRING GM-6704182
 D—WASHER GM-6765624
 E—WASHER GM-6765623
 F—DETENT BALL GM-169111
 G—STEERING VALVE BODY GM-6765622
 H—STEERING-SHAFT OIL SEAL GM-6700686
 J—THRUST WASHER GM-8894389
 K—INDICATOR GM-6765476
 L—SNAP RING GM-6701304
 M—PIPE PLUG (2) GM-444689
 N—BOLT (5) GM-186303
 P—BOLT (5) GM-181349
 Q—NUT GM-6766159
 R—SPRING RETAINER GM-6765447
 S—SPRING GM-6765614
 T—RIGHT STEERING VALVE GM-6765445
 U—ANNULAR GASKET GM-8892905
 V—RIGHT STEERING VALVE PLUG GM-6765615
 W—LEFT STEERING VALVE PLUG GM-6765615
 X—ANNULAR GASKET GM-8892905
 Y—LEFT STEERING VALVE GM-6765445
 Z—SPRING GM-6765614
 AA—SPRING RETAINER GM-6765447
 BB—NUT GM-6766159
 CC—WASHER GM-6765623
 DD—WASHER GM-6765624
 EE—HEX-HEAD SCREW GM-6765625
 FF—STEERING LEVER SHAFT GM-6765616
 GG—GASKET GM-6765627
 HH—VALVE BODY-TO-PLATE GASKET GM-6765626
 JJ—BOLT (4) GM-429002
 KK—BOLT (1) GM-221583
 LL—STEERING VALVE BODY PLATE GM-6765613
 MM—PLATE-TO-HOUSING GASKET GM-6765439

Figure 229—Continued.

- to the screw-stop shim pack. Repeat this procedure to determine the proper adjustment of the left steering valve (Y).
- (7) With both valves adjusted, move the right steering valve (T) in until the lever is against the stop screw. Check the valve to see that there is a minimum opening of $\frac{1}{32}$ -inch between the middle land of the valve and the clutch-line oil cavity. Measure from the side of the middle land nearest the spring (S) to the side of the oil cavity nearest the spring. This opening may be measured from the bottom side of the valve body.
 - (8) Repeat this check on the left steering valve (Y). If there is less than $\frac{1}{32}$ -inch opening on either valve, replace the steering-valve body.

55. Assembly of Control Valve Bodies

a. ASSEMBLY OF RANGE-CONTROL VALVE BODY (fig. 227).

- (1) Install the cooler-by-pass valve (JJ), spring (AA), and valve guide (BB). Using snap ring pliers, install the snap ring. (CC).
- (2) Install the lubricating-oil-regulator valve (LL), valve spring (HH), and valve guide (GG) in the valve body (QQ). Using a $1\frac{1}{8}$ -inch wrench, install the lubricating oil regulator plug (EE) and the "O" ring gasket (FF) over the valve.
- (3) Install the converter-regulator valve (ZZ) in the valve sleeve (NN). Install the converter-regulator valve spring (AB). Using a $1\frac{1}{8}$ -inch wrench, install the converter-regulator plug (AD) and the "O" ring gasket (AC).
- (4) Install the cone-shaped main-oil-regulator valve (VV) and spring (WW). Using a $1\frac{1}{8}$ -inch wrench, replace the main-oil-regulator valve plug (YY) and the "O" ring gasket (XX).
- (5) Install the range-selector valve (D) in the valve body, inserting the collar end first. Install the range selector valve cover (B) and gasket (C). Secure the cover to the valve body with four $\frac{5}{16}$ -inch bolts (A).
- (6) Install the shift-valve inner lever assembly (RR) in the valve body, engaging the arm in the control collar of the valve (D). Lay the valve body, bottom side

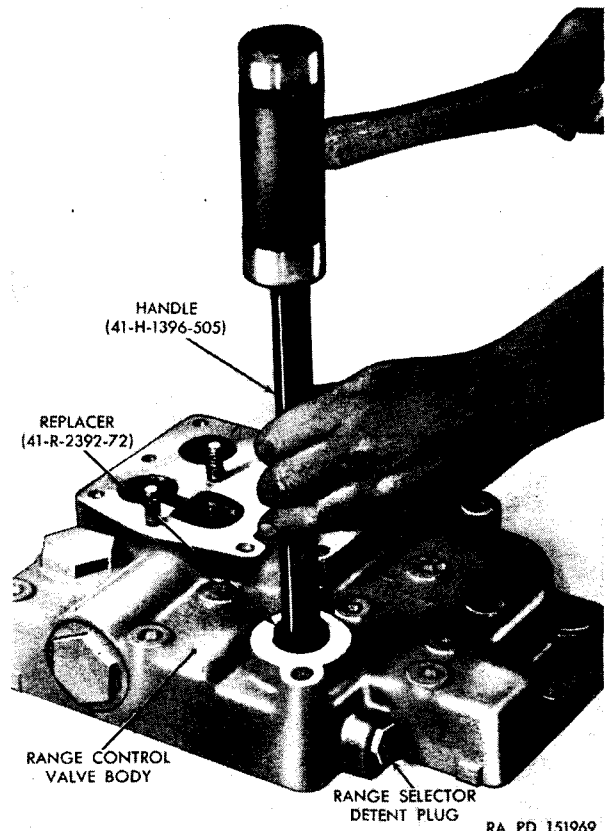


Figure 230. Replacing range-selector-shaft oil seal.

- down, on the assembly table. Install the thrust washer (V) on the selector shaft. Install the selector indicator (W) on the shaft, indexing it to the master spline. Press the indicator against the shoulder on the shaft. Secure the indicator and shaft with a snap ring (Z).
- (7) Install the overspeed-safety-valve spring (J) in the valve sleeve (N). Install the overspeed-safety valve (G) inserting the long guide-pin end into the spring. Using a $\frac{7}{8}$ -inch wrench, install the plug (E) and the "O" ring gasket (F).
 - (8) Install the shift-lever poppet (S) and spring poppet (T). Install the range selector detent plug (Y) and copper gasket (X), tightening the plug with a $\frac{7}{8}$ -inch wrench.

b. ASSEMBLY OF STEERING VALVE BODY (fig. 229).

- (1) Install both steering-valve assemblies (Q through T, and Y through BB) in the valve body (G) with the spring-adjust-

ment and inserted first. Using a 1½-inch wrench, install the steering valve plugs (W and V) and the annular gaskets (U and X) over the end of each valve. Torque the plugs 90 to 100 pound-feet.

- (2) Install the steering-lever shaft (FF) in the valve body, from the bottom, engaging the shaft in the two spring retainers (R and AA). Lay the valve body, bottom side down, on the assembly table.
- (3) During the following, be certain to hold the steering-lever shaft in the two spring

retainers until the snap ring (L) is installed. Place the thrust washer (J) over the steering lever shaft (FF). Install the indicator (K) on the shaft, indexing it to the master spline. Press the indicator against the shoulder on the shaft. Secure the indicator and shaft with a snap ring (L).

- (4) Install the detent ball (F) and shaft detent spring (C) in the valve body. Using a ¾-inch wrench, install the gasket (GG) and shaft lever poppet plug (A) in the valve body.

Section XI. REBUILD OF LEFT HOUSING

56. Disassembly of Left Housing

a. LEFT HOUSING. Place the left housing on the assembly table so that the right housing mounting surface is up. Refer to figure 235.

b. STEERING-DIFFERENTIAL BEVEL PINION ASSEMBLY. Tap the steering differential assembly lightly with a soft hammer to loosen it from the housing dowels in each end of the differential shaft. Lift the steering-differential bevel pinion assembly off the dowels being careful to prevent the sleeves and gear assemblies from sliding off the shaft (fig. 231). Lift the right- and left-steering shaft assembly from the housing (fig. 232).

c. LEFT STEERING CROSS SHAFT.

- (1) Remove a cotter pin from each of the four nuts which secure the bearing retainer and left steering cross-shaft bearing cage. Remove the four nuts using a ½-inch wrench.
- (2) Lift the left steering-cross-shaft and bearing assembly out of the housing (fig. 233).

Note. If the bearing cage does not come out with the assembly, separate and remove the cage from the housing using two ⅝-inch jack screws (fig. 234). Remove the shims and keep them with the left-steering cross shaft assembly.

- (3) Using a ½-inch wrench, remove the nuts and the lock plate which secure the fan-and-pump drive shaft. Install the adapter (41-A-18-360) in the end of the shaft
- (4) Using remover (41-R-2373-216), remove the fan and pump drive shaft (fig. 235).

Remove the fan and pump drive pinion assembly (fig. 236).

d. INPUT AND CONVERTER GEARING.

- (1) Remove the lock ring from the input-shaft lock nut, using a screwdriver. Install the spanner wrench on the input-shaft lock nut. Install the gear holding tool to lock the input shaft (fig. 237).

Note. These are improvised tools for the purpose of removing or installing the lock nut. Other improvisations may be used for this purpose.

Loosen, but do not remove, the input-shaft lock nut.

Note. This nut has a left-hand thread and has been torqued to 350 pound-feet.

- (2) Remove a cotter pin from each of the four nuts using a ¾-inch wrench. Using a pry-bar between the front bearing support and the input-driven bevel gear, loosen the input-shaft front and center bearing supports from the dowels in the housing. Use a soft hammer on the converter-output shaft bevel gear to separate the output shaft from the converter ground sleeve.

Note. It will be necessary to lift the input gearing assembly while separating the output shaft from the ground sleeve (fig. 238).

- (3) Install a rod through the input shaft and remove the input bevel gearing and transfer gearing as an assembly (fig. 239). Remove the converter output shaft and bevel gear assembly (fig. 240). Remove

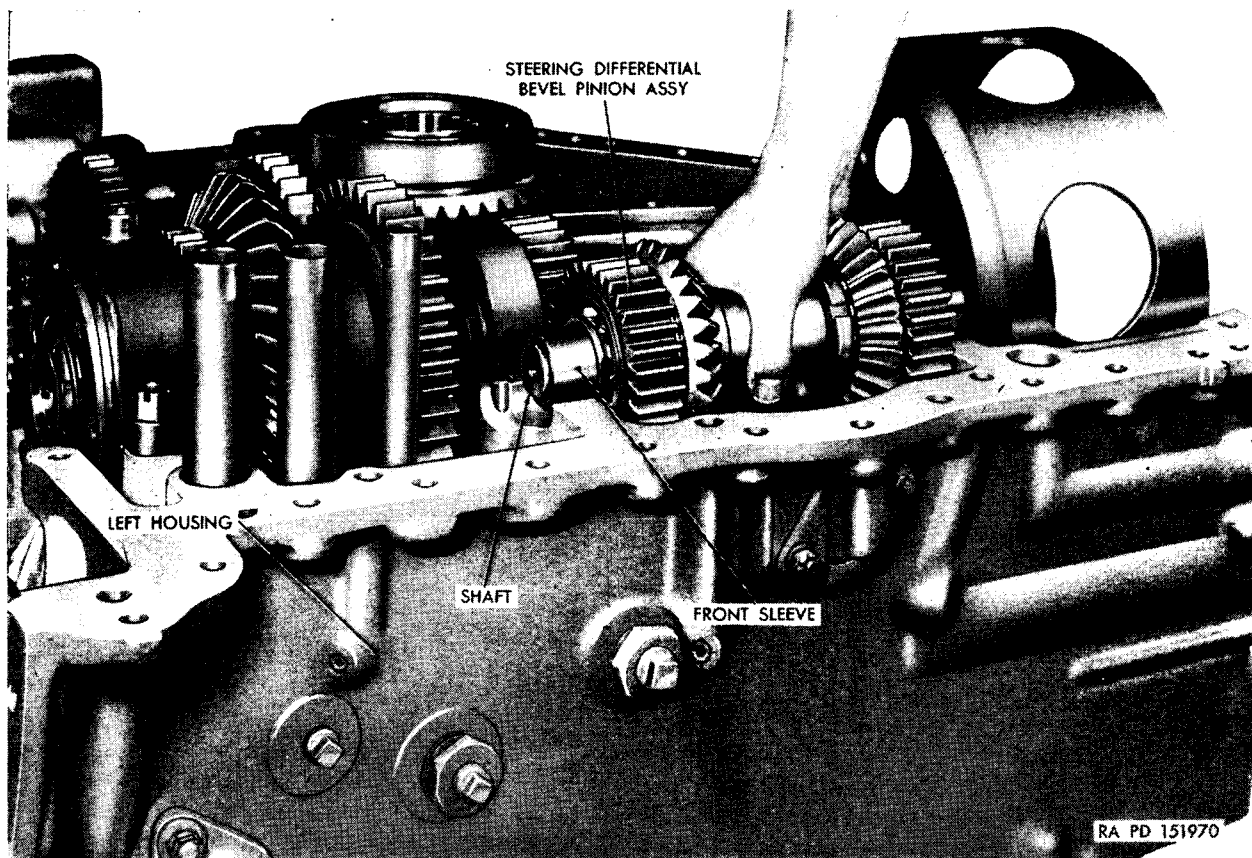


Figure 231. Removing or installing steering-differential-bevel pinion assembly.

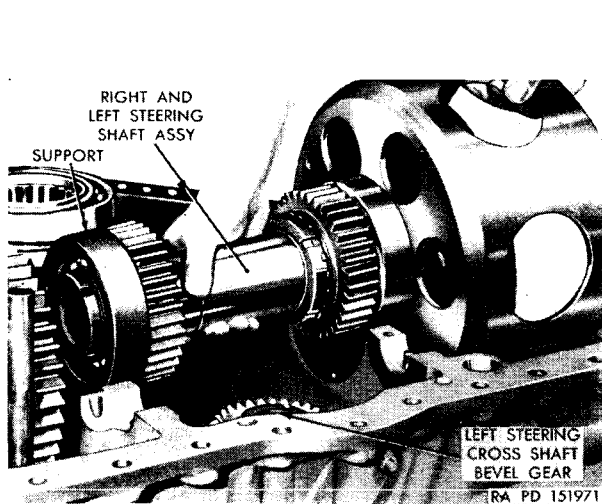


Figure 232. Removing or installing right- and left-steering shaft assembly.

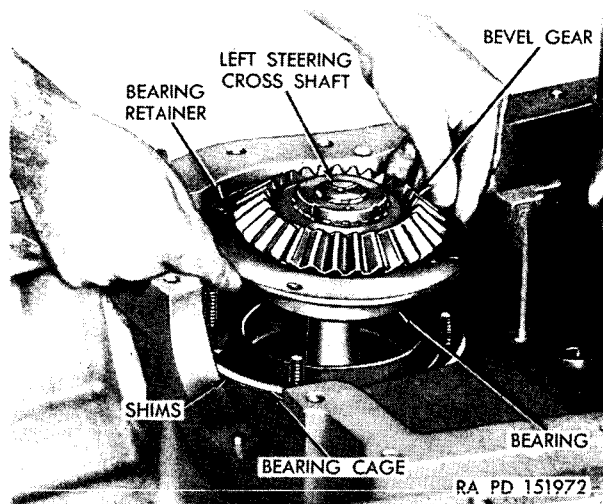


Figure 233. Removing or installing left steering-cross-shaft and bearing assembly.

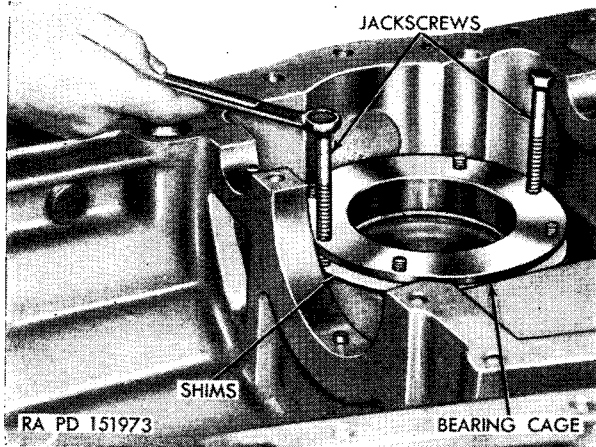


Figure 234. Removing bearing cage.

the shims from the converter ground sleeve and wire together for safekeeping.

e. ACCESSORY GEARING.

- (1) Remove a cotter pin from each of the three nuts that secure the input-scavenge and converter circulating pump assembly to the housing. Remove the three nuts using a $\frac{1}{2}$ -inch wrench, and remove the washers and pump assembly (fig. 241).

- (2) Remove the fan and pump idler-shaft retaining snap ring using snap ring pliers (41-P-1992-34). Hold the idler gear to keep it from falling and pull the shaft from the housing using remover (41-R-2373-216) and adapter (41-A-18-360) (fig. 242).

- (3) Using a $\frac{7}{16}$ -inch wrench, remove four bolts and washers from the converter-oil-outlet cover and remove it from the housing (fig. 243). Install a piece of strap iron, $\frac{1}{8}$ -inch thick by $1\frac{1}{16}$ -inches wide by approximately 10-inches long, in the slot on the converter-circulating pump-by-pass valve body. Using an adjustable wrench to turn the strap iron, screw the valve assembly out of the housing (fig. 244).

f. PUMP-AND-FAN-DRIVE COVER.

- (1) Attach the lifting sling (C7083778) to the housing, using two bolts through the bolt holes in the top split-line mounting flange. Using a hoist, raise the housing and lower it so that it rests on its bottom on the assembly table (fig. 245).

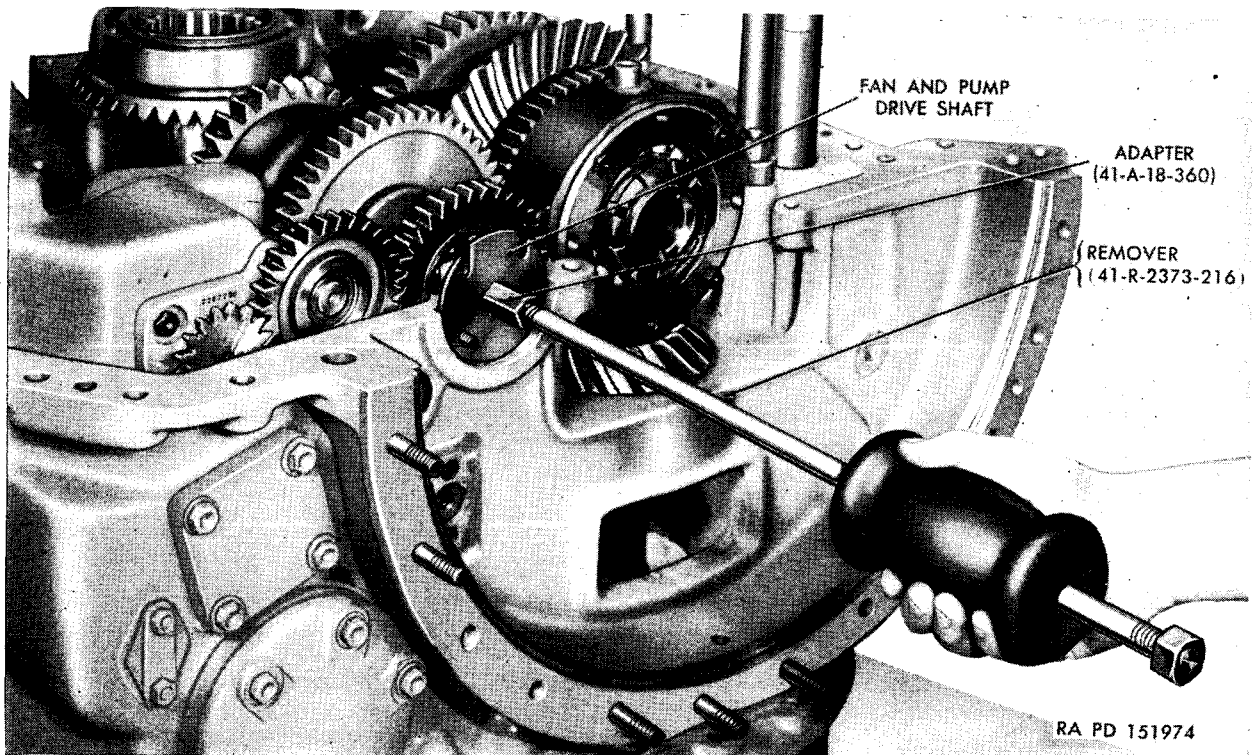


Figure 235. Removing fan and pump drive shaft.

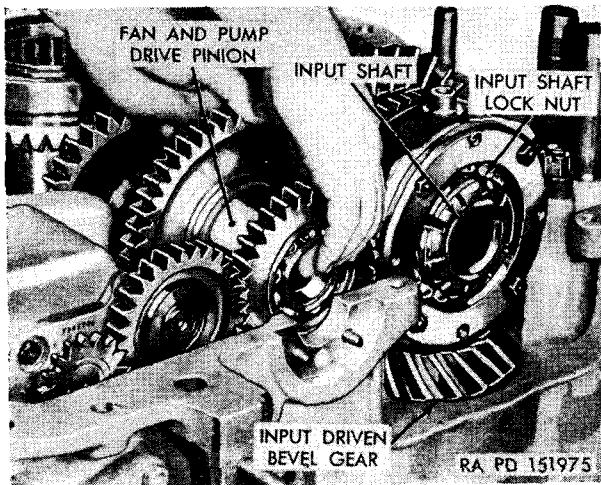


Figure 236. Removing or installing fan and pump drive pinion assembly.

- (2) Using a $\frac{1}{16}$ -inch wrench, remove the six jam nuts, nuts, and washers from the pump and fan drive cover. Remove the cover and gasket.

g. INPUT-DRIVEN BEVEL GEAR.

- (1) Using a $\frac{1}{2}$ -inch wrench, remove six bolts from the steering-over-speed-limit pump and remove it from the housing (fig. 246). Using a $\frac{1}{16}$ -inch wrench, remove six bolts from the input-driven-bevel gear left bearing retainer and remove it from the housing (fig. 247).
- (2) Separate and remove the cage and bearing assembly from the gear, by using as jackscrews two of the bolts just removed from the retainer (fig. 248).

Note. It may be necessary to use longer bolts to remove the assembly.

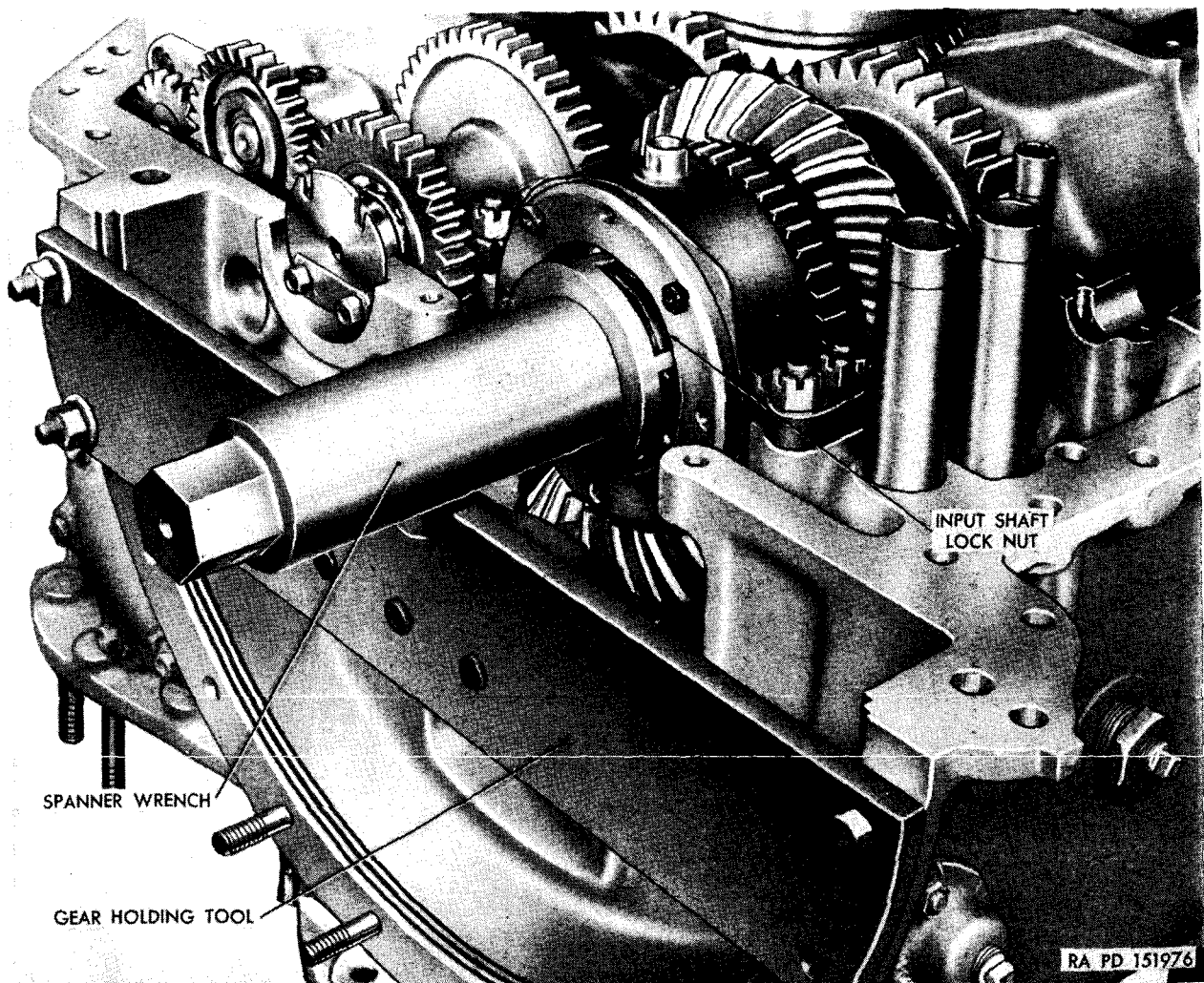


Figure 237. Improved tools installed.

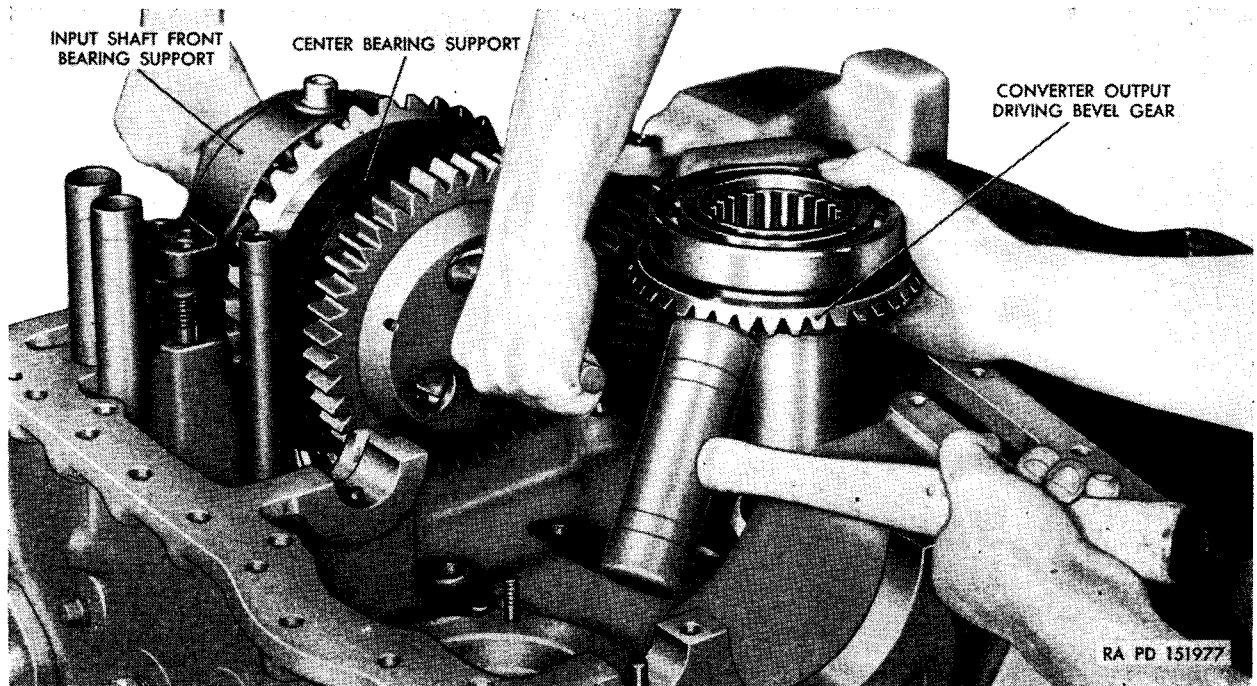


Figure 238. Separating input and converter gearing.

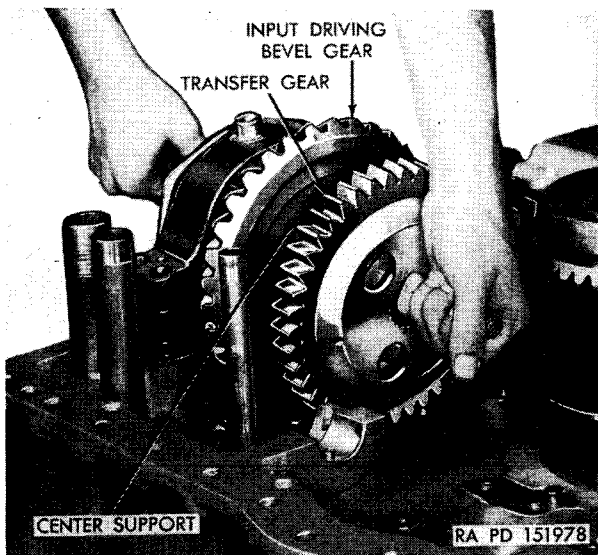


Figure 239. Removing or installing input gearing.

Remove the shims and wire them together for safekeeping. Remove the input-driven-bevel gear (fig. 236).

h. OUTLET TUBES. Using a $\frac{1}{2}$ -inch socket, remove four bolts from the converter, circulating-pump-outlet tube and remove it from the housing (fig. 249). Remove four bolts and washers from the input-ump-pump-outlet tube and remove it from the housing (fig. 250).

i. FAN AND PUMP GEARING.

- (1) Bend back the tabs on the fan-drive lock washer. Using a soft drift between the fan and pump drive gear and the input pressure pump drive gear, remove the nuts from the fan and pump drive coupling with the aid of a spanner wrench (41-W-640-285) (fig. 251). Pull the fan-drive gear from the fan drive coupling (fig. 252).
- (2) Using a $\frac{1}{2}$ -inch socket, remove the six bolts from the fan-drive-coupling bearing cage. Use two $\frac{5}{16}$ -inch jack screws to separate the cage (fig. 253) from the housing. Remove the coupling assembly and gasket from the housing (fig. 254).
- (3) Using snap ring pliers (41-P-1992-27), remove the snap ring which retains the input-pressure-pump drive gear and bearing assembly to the pump-drive spindle (fig. 255). Bend back the tabs on the spindle lock plate and, using a $\frac{1}{2}$ -inch wrench, remove the nuts and lock plate from the spindle flange.
- (4) Using remover (41-R-2373-216) and adapter (41-A-18-360), remove the spindle from the pump-drive-gear and bearing assembly (fig. 256).

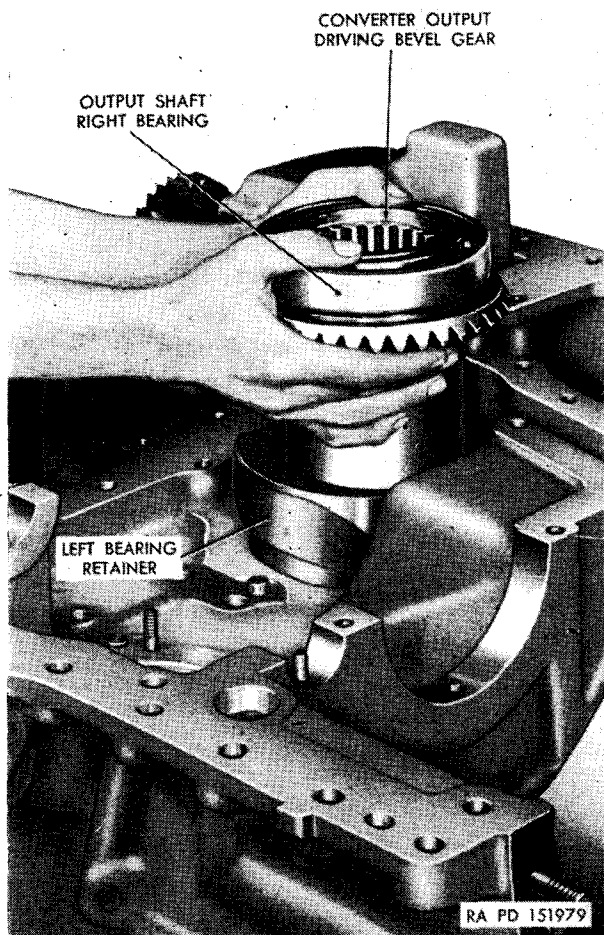


Figure 240. Removing or installing converter output gearing.

j. **CONVERTER GROUND SLEEVE.** Using a $\frac{1}{16}$ -inch socket, remove the six bolts which secure the converter ground sleeve assembly to the housing. Separate the ground sleeve from the housing using three $\frac{3}{8}$ -inch jack screws (fig. 257). Remove the ground sleeve.

Note. It is necessary to insert a small metal block behind the ground sleeve to afford a bearing surface for one of the jack screws.

57. Cleaning

Refer to paragraph 25 for cleaning instructions.

58. Inspection and Repair

a. **GENERAL.** Refer to paragraph 26a through l for general inspection and repair procedure. Refer to paragraph 109 for serviceability measurements and wear limits.

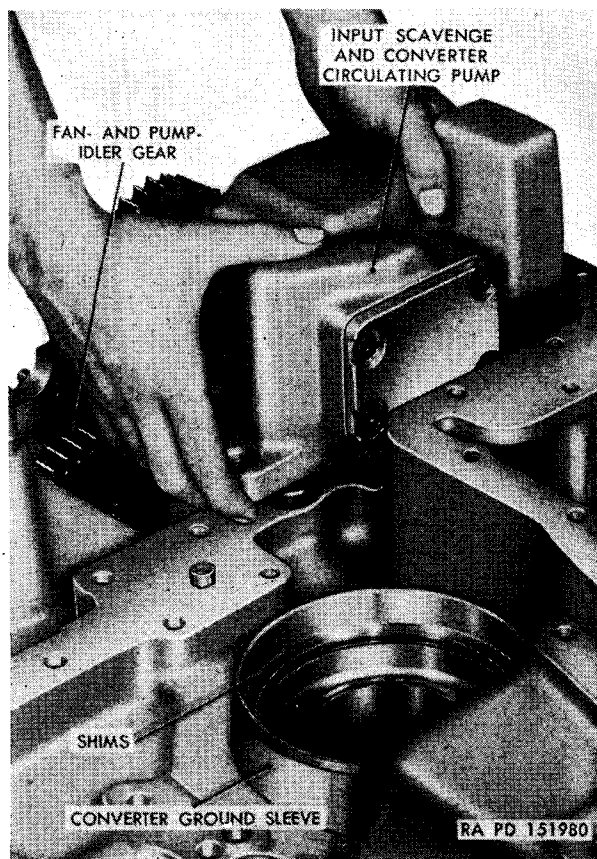


Figure 241. Removing or installing input-scavenge and converter circulating pump assembly.

b. STEERING-DIFFERENTIAL-BEVEL PINION ASSEMBLY (fig. 258).

- (1) If inspection indicates that disassembly is necessary, remove the front sleeve and the front-steering-bevel pinion assembly (fig. 259) from the steering-differential shaft.

Caution: Make sure that the sleeves and the pinion assemblies are marked to identify which should be assembled on the front and which on the rear, end of the shaft. The rear end of the shaft has a drilled hole through it. If the marks on the parts are not distinguishable, etch them properly before they are removed from the shaft.

Remove the rear sleeve and the rear-steering-bevel pinion assembly from the shaft.

- (2) If a steering-differential-bevel pinion, spur gear, or ball bearing is defective, place the pinion assembly in a vise with soft

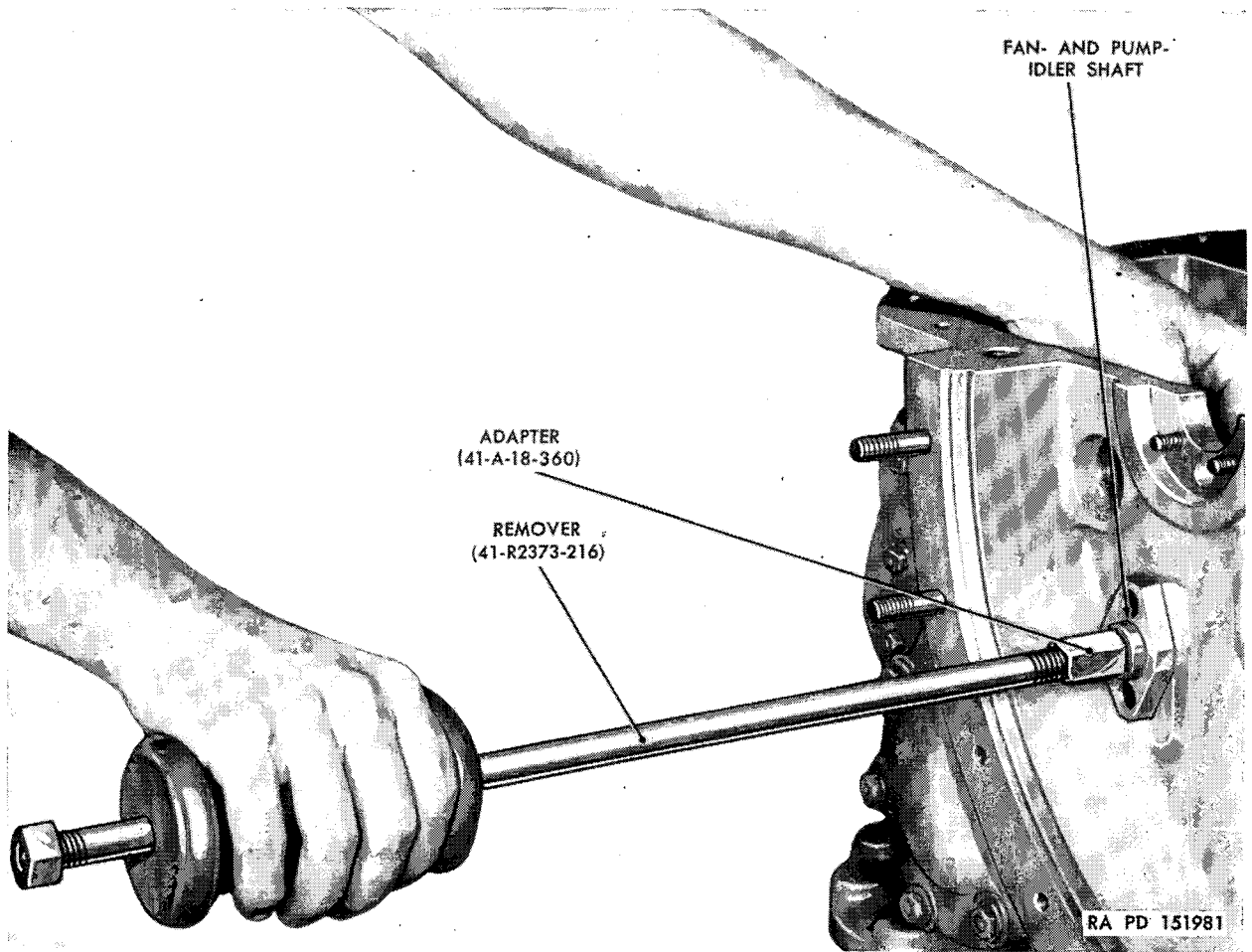


Figure 242. Removing fan and pump-idler shaft.

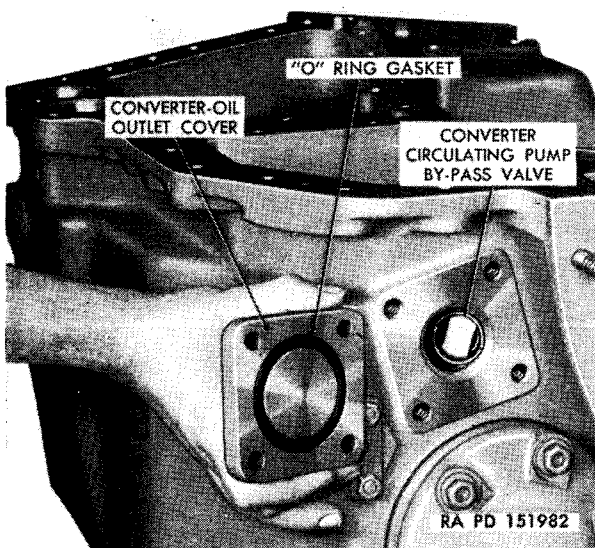


Figure 243. Removing or installing converter-oil-outlet cover.

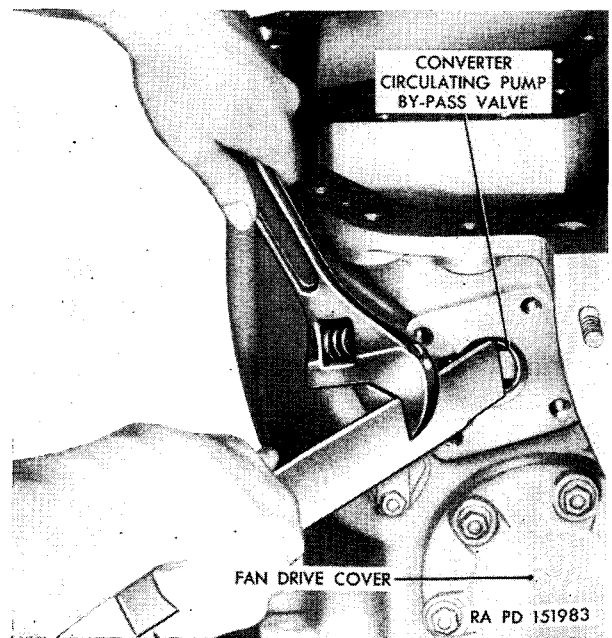


Figure 244. Removing or installing circulating pump-by-pass valve assembly.

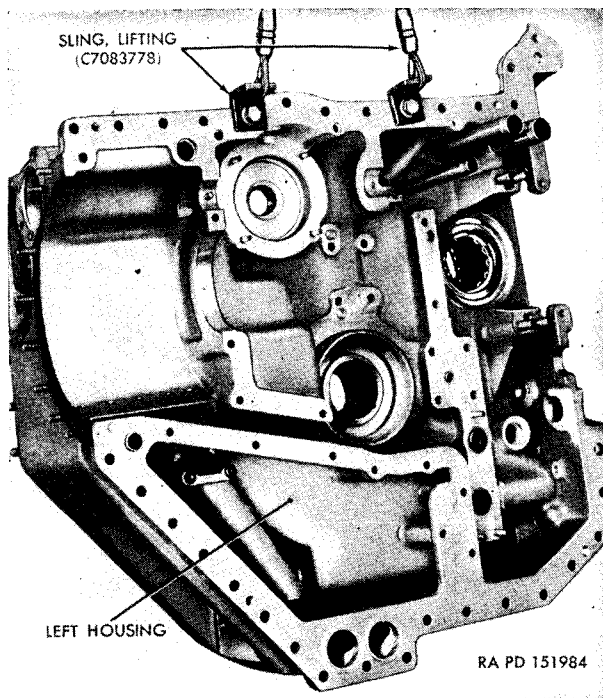


Figure 245. Changing left housing position.

jaws. Using a small chisel or punch, bend back the tab of the lock washer. Loosen and remove the lock nut using spanner wrench (41-W-640-310) (fig. 260).

- (3) Remove the lock washer and bevel pinion from the splined hub of the spur gear. Remove the shims and wire them to-

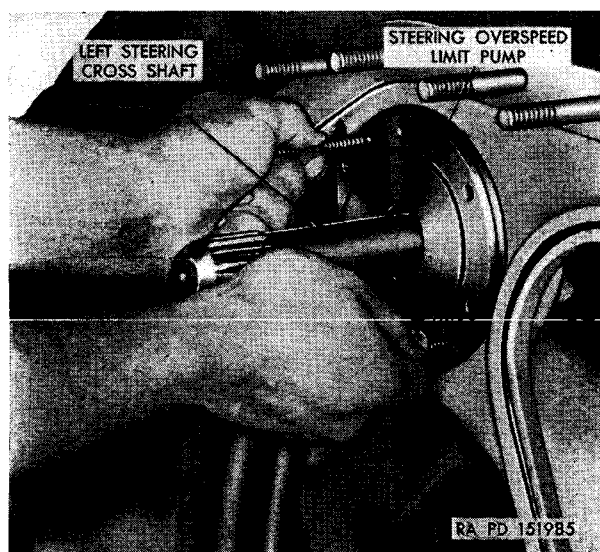


Figure 246. Removing steering-overspeed-limit pump.

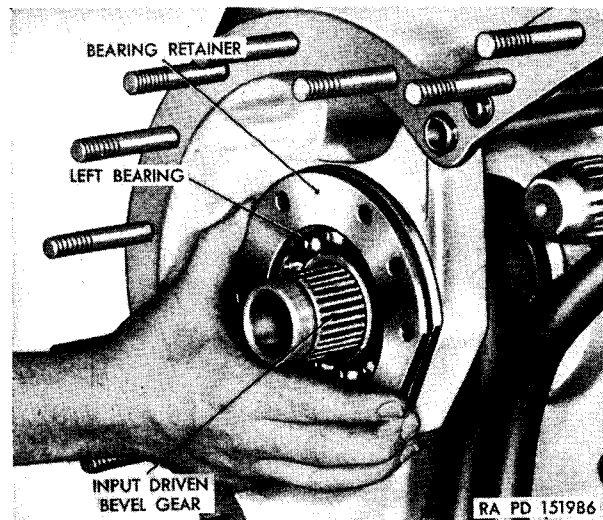


Figure 247. Removing or installing bearing retainer.

gether. Keep them with the pinion assembly.

Note. If a steering-differential-bevel pinion is defective, it will be necessary to replace both steering-differential-bevel pinions, as well as the right steering-cross-shaft gear and the left steering-cross-shaft gear because these four gears comprise a matched set.

- (4) If a spur gear or ball bearing is defective, separate the bearing from the gear by driving with a drift, through the holes provided in the gear. If the needle bearing is defective, drive it out of the spur gear using a hammer and drift.

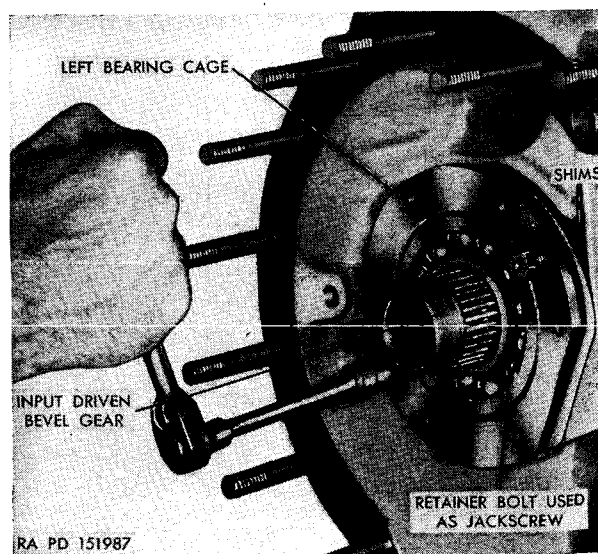


Figure 248. Removing cage and bearing assembly.

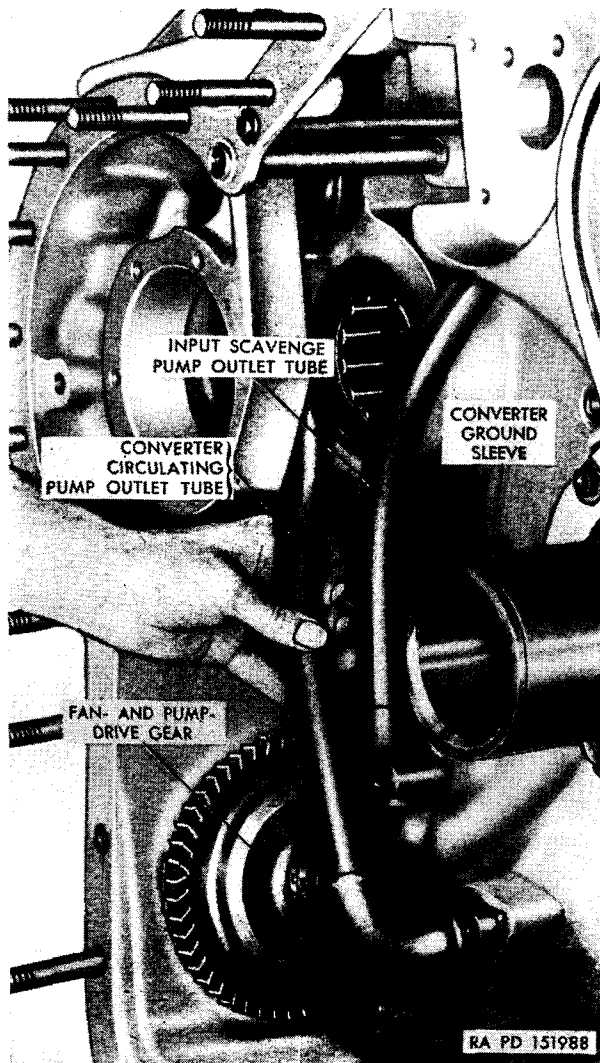


Figure 249. Removing or installing converter-circulating-pump-outlet tube.

Note. Do not attempt to remove the needle bearing unless it is defective; removal will fail the bearing.

- (5) If needle bearing was removed, install a new needle bearing, numbered side out, using the replacer (41-R-2381-875) and handle (41-H-1396-510) (fig. 261). Install the ball bearing, numbered side out, in the spur gear using replacer (41-R-2392-465) and handle (41-H-1396-510) (fig. 262).
- (6) If it has not been necessary to replace a bevel pinion or spur gear and if the original shims which were removed from the gear assemblies are intact, assemble

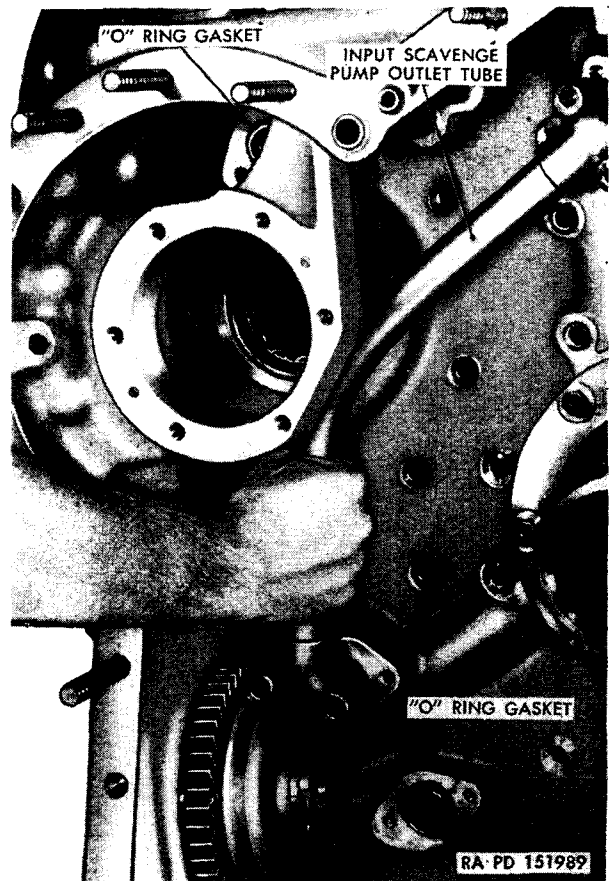


Figure 250. Removing or installing input-scamge-pump-outlet tube.

the steering differential in accordance with the procedure given in (13) below.

- (7) Whenever bevel pinions are replaced, or whenever any part affecting the positioning of the bevel pinions is replaced, it is necessary that the mating pinions be mounted in such a manner that the desired backlash and mesh pattern can be obtained.
- (8) The first step in obtaining the backlash and mesh pattern is to compute the nominal shim dimension. The nominal shim dimension may be determined with the aid of the proper pinion measuring chart and formula, certain dimensions to be found on the pinions and the housing, and by making certain measurements.
- (9) The second step is to install and secure the pinions during the assembly of the left housing for a check on the gear mesh pattern and backlash. Refer to para-

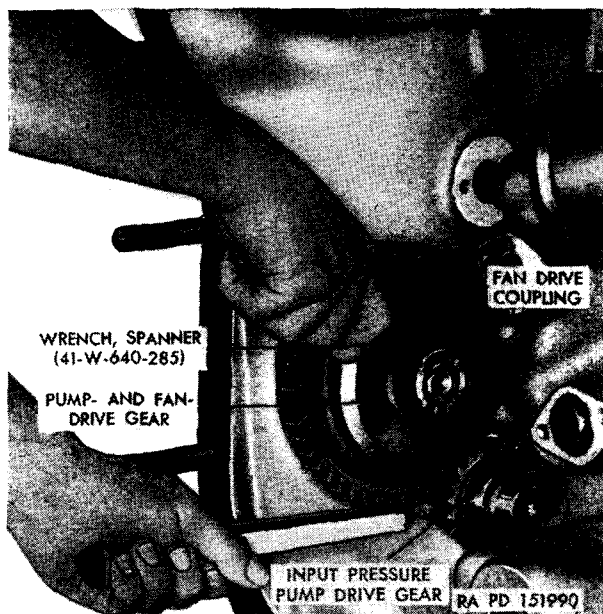


Figure 251. Removing or installing fan-drive-coupling nut.

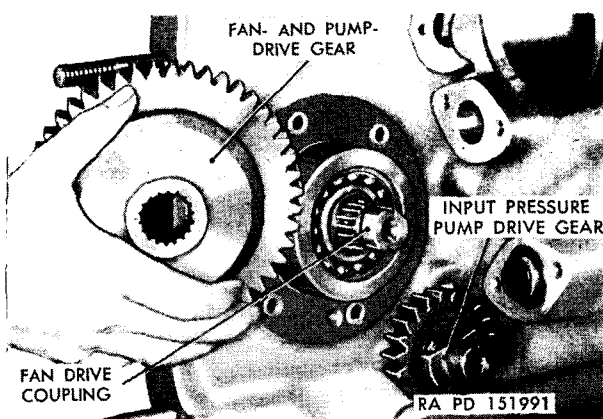


Figure 252. Removing or installing fan and pump-drive gear.

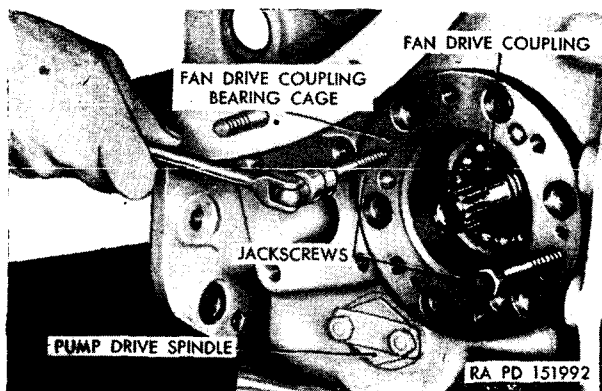


Figure 253. Removing fan-drive-coupling bearing cage.

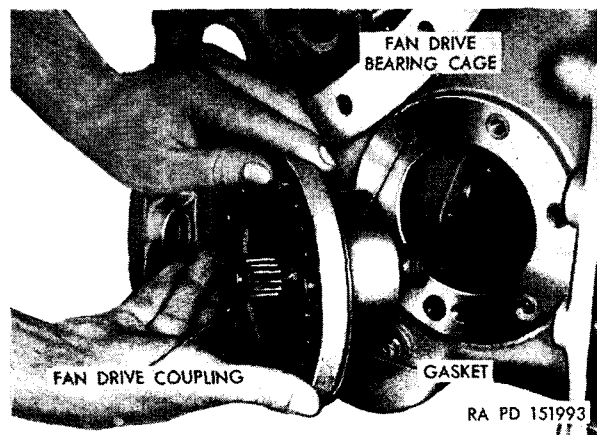


Figure 254. Removing or installing coupling assembly.

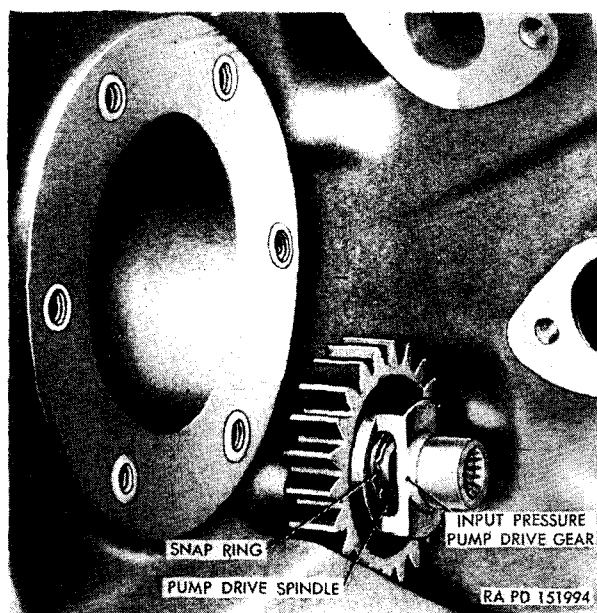


Figure 255. Snap ring location.

- graph 59/ for the bevel pinion backlash and mesh pattern adjustment procedure.
- (10) To determine the nominal shim pack for the rear-steering bevel gear (fig. 263), place the rear sleeve, flange side up, on a surface plate. Place the spur gear and ball bearing assembly on top of the sleeve so that the ball bearing inner race is against the sleeve.
 - (11) Measure and record the distance from the bottom side of the flange on the sleeve, to top side of the spur gear. Label this measurement $Z + Y$. To this measurement add the dimension X , the mounting

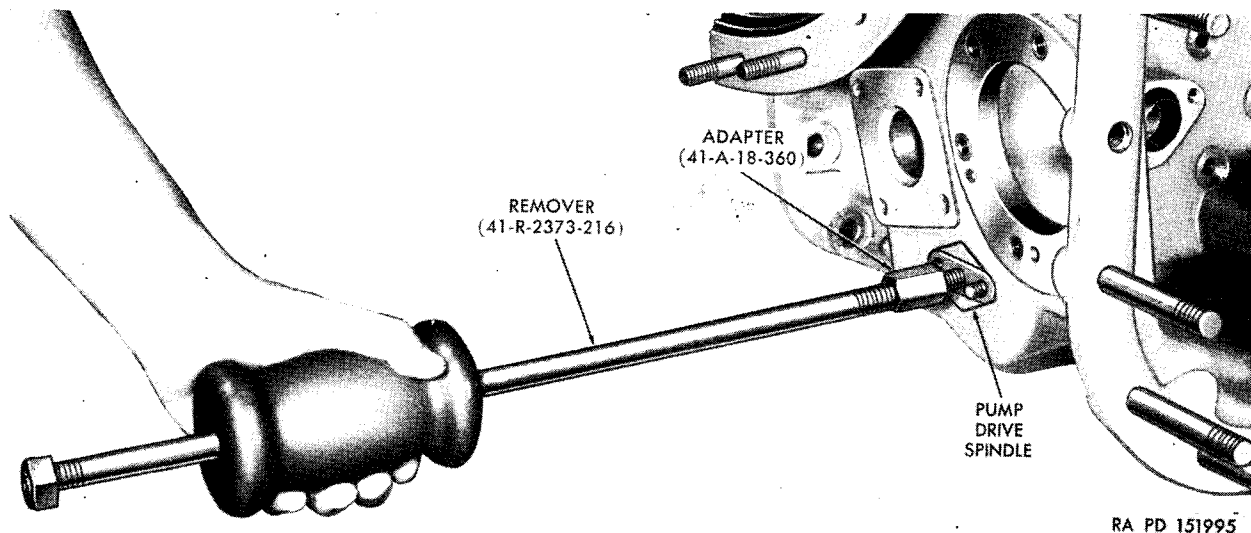


Figure 256. Removing pump-drive-gear and bearing spindle.

distance, which is etched on the bevel pinion. Subtract the total of $X + Y + Z$ from the dimension G , given on the left housing. The result will be the nominal shim to be used on the rear-steering bevel pinion assembly. The formula is $G - (X + Y + Z) = \text{Shim}$.

- (12) The procedure for determining the nominal shim pack for the front-steering bevel pinion assembly is the same as that for the rear bevel pinion assembly. However, the H dimension, given on the left housing, is used instead of the G dimension. The formula is $H - (X + Y + Z) = \text{Shim}$.

Note. Be sure that the X , Y , and Z dimensions are determined for the front-steering bevel pinion assembly.

- (13) Install the proper shim pack and bevel pinion on the spur gear. Install the tabbed lock washer and lock nut. Tighten the lock nut to 350 pound-feet using spanner wrench (41-W-640-310) (fig. 260) and bend the tab of the lock washer into the slot on the lock nut. Install the pinion assembly and the sleeve, both marked "rear," on the drilled end of the steering-differential shaft (fig. 264). Install the pinion assembly and the sleeve, both marked "front," on the undrilled end of the steering-differential shaft (fig. 259).

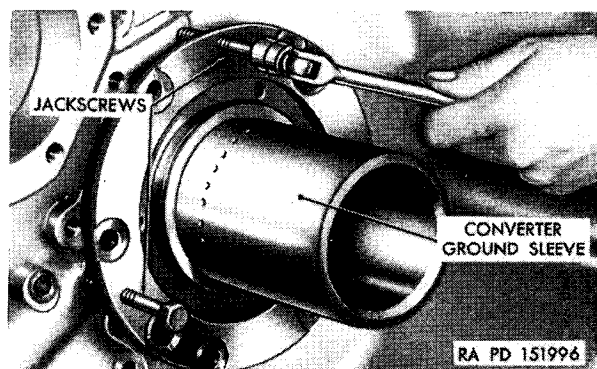


Figure 257. Separating converter ground sleeve from left housing.

c. RIGHT AND LEFT STEERING-SHAFT ASSEMBLY (fig. 265).

- (1) Using a $\frac{3}{32}$ -inch wrench, remove the lock screw from the right steering-shaft-bearing nut. Remove the lock nut using spanner wrench (41-W-640-305) (fig. 266) and remove the splined spacer. Remove the right steering-shaft gear and bearing assembly (fig. 267).
- (2) If inspection indicates a defective bearing, further disassembly is necessary. Drive or pry the right steering shaft gear out of the bearing (fig. 268). Remove the bearing-retaining snap ring, using a screwdriver, from the right steering shaft bearing support (fig. 269). Press the bearing out of the bearing support.

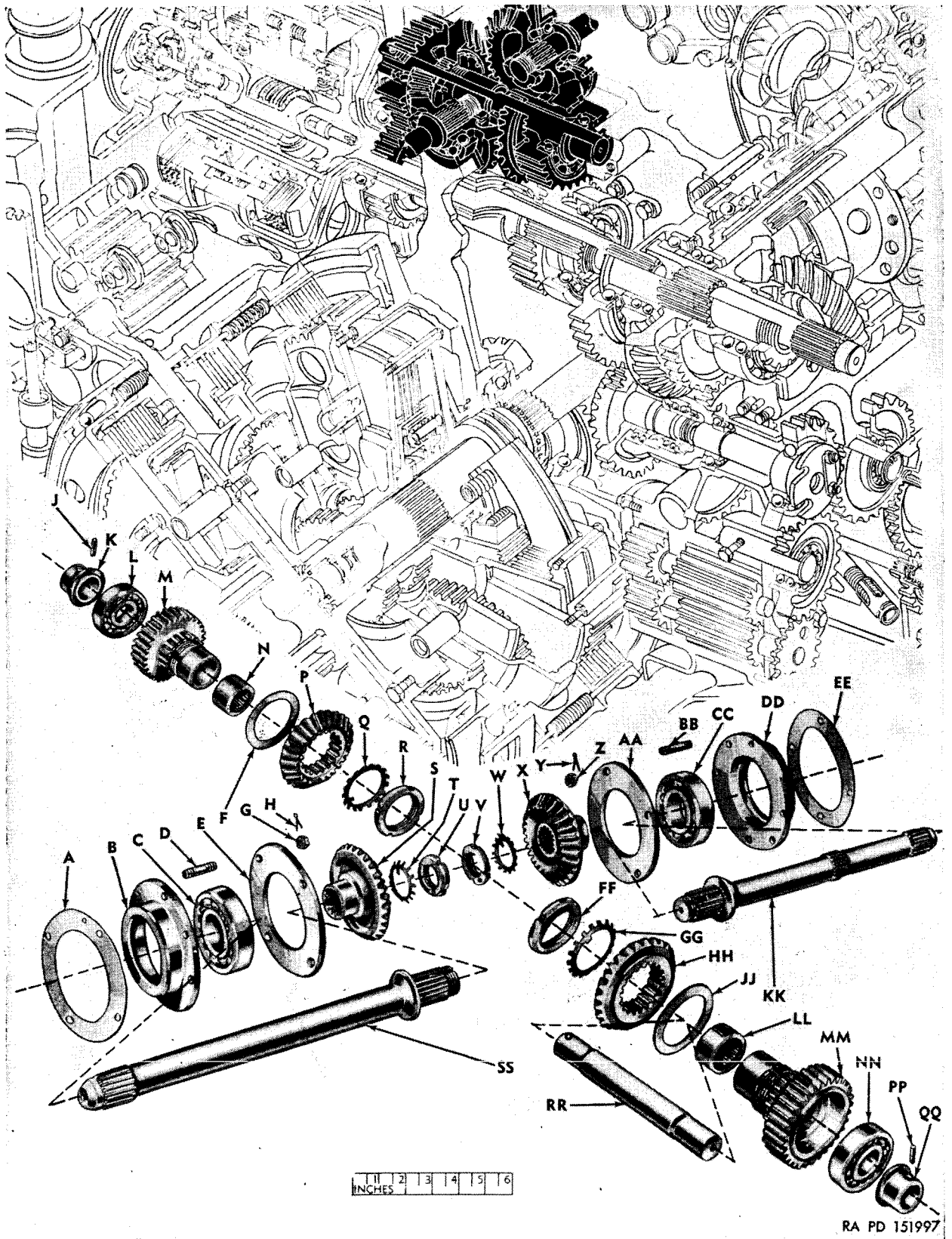


Figure 258. Steering differential assembly—exploded view.

A—SHIM GM-6760346
 B—BEARING CAGE GM-6760333
 C—BEARING GM-903309
 D—STUD (4) GM-6760144
 E—BEARING RETAINER GM-6760339
 F—SHIM GM-6765325
 G—NUT (4) GM-119251
 H—COTTER PIN (4) GM-107761
 J—DOWEL GM-141221
 K—REAR SLEEVE GM-6704494
 L—BEARING GM-903306
 M—STEERING DIFFERENTIAL SPUR GEAR GM-6765328
 N—BEARING GM-6704022
 P—REAR STEERING BEVEL PINION GM-6765327
 Q—LOCK WASHER GM-6765460
 R—LOCK NUT GM-127714
 S—RIGHT STEERING CROSS SHAFT GEAR GM-6763962
 T—LOCK WASHER GM 6760191
 U—LOCK NUT GM-6760192
 V—LOCK NUT GM-6760192
 W—LOCK WASHER GM-6760191
 X—LEFT STEERING CROSS SHAFT GEAR GM-6763962
 Y—COTTER PIN (4) GM-107761
 Z—NUT (4) GM-119251
 AA—BEARING RETAINER GM-6760339
 BB—STUD (4) GM-6760144
 CC—BEARING GM-903309
 DD—BEARING CAGE GM-6760333
 EE—SHIM GM-6760346
 FF—LOCK NUT GM-127714
 GG—LOCK WASHER GM-6765460
 HH—FRONT STEERING BEVEL PINION GM-6765327
 JJ—SHIM GM-6765325
 KK—LEFT STEERING CROSS SHAFT GM-6763961
 LL—BEARING GM-6704022
 MM—STEERING DIFFERENTIAL SPUR GEAR GM-6765328
 NN—BEARING GM-903306
 PP—DOWEL GM-141215
 QQ—FRONT SLEEVE GM-6704494
 RR—STEERING DIFFERENTIAL SHAFT GM-6760023
 SS—RIGHT STEERING CROSS SHAFT GM-6760331

Figure 258—Continued.

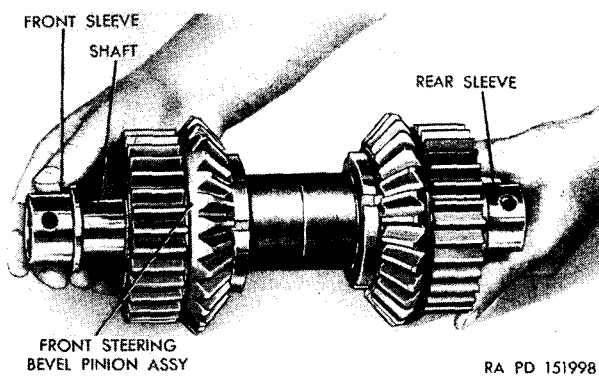


Figure 259. Removing or installing front sleeve.

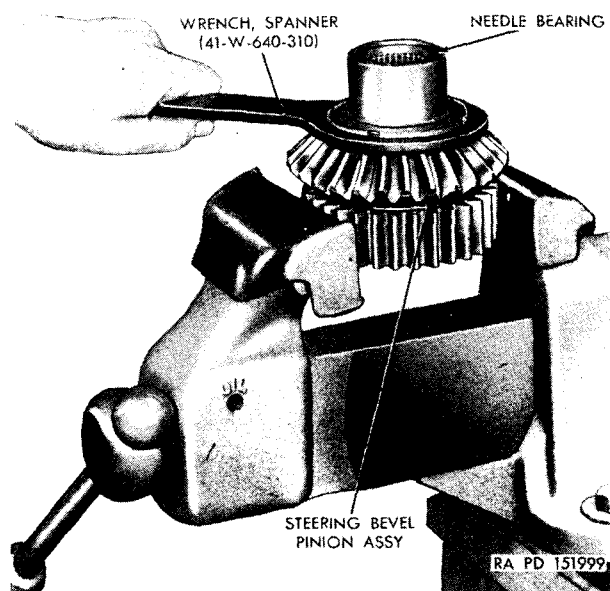


Figure 260. Removing or installing lock nut.

- (3) Remove the two halves of the split-spacer (fig. 270). Remove the left steering shaft from the right steering shaft (fig. 271).
- (4) Inspect the right steering shaft and the left steering shaft assemblies. If the left steering-shaft bearing or gear is defective, it will be necessary to disassemble the left steering shaft. To disassemble, bend back the tabs on the lock washer. Using spanner wrench (41-W-640-315), remove the lock nut from the left steering shaft (fig. 272).
- (5) Remove the tabbed lock washer and the left steering shaft gear from the shaft. If inspection shows the bearing to be defective, turn the shaft over and

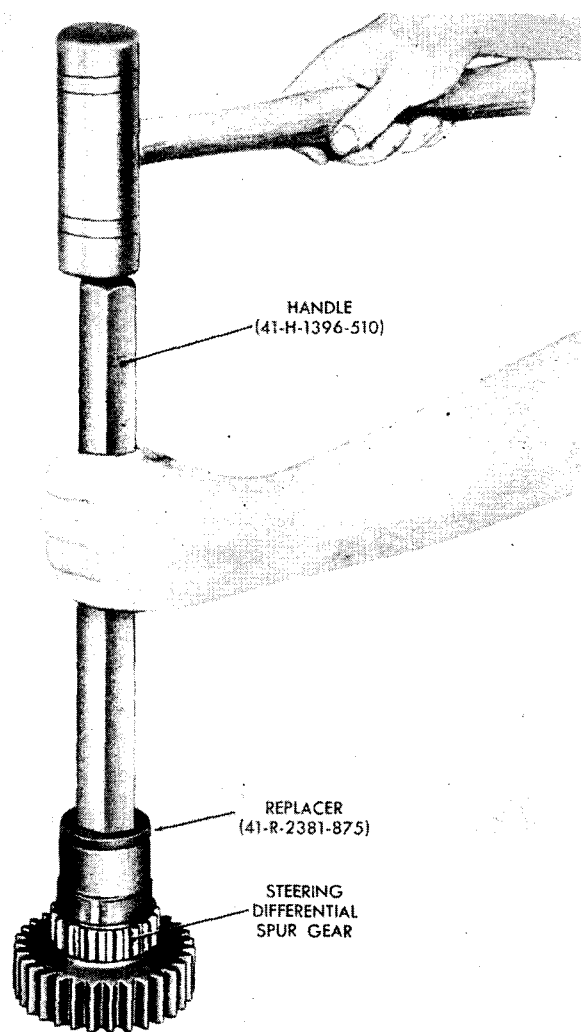


Figure 261. Installing spur-gear needle bearing.

- remove the bearing and cage assembly, using a drift through the three holes provided in the left steering shaft (fig. 273).
 - (3) Remove the snap ring from the bearing cage using a screwdriver. Drive or press the bearing out of the cage. Inspect the left-steering shaft.
- Note.* Do not remove the bushings unless they are defective. If defective, press or cut them out.
- Inspect the bearing cage. Replace all defective parts.
- (4) To assemble the left-steering shaft, install the ball bearing in the cage, lettered side down, using an arbor press or drift to seat the bearing. Install the bearing-

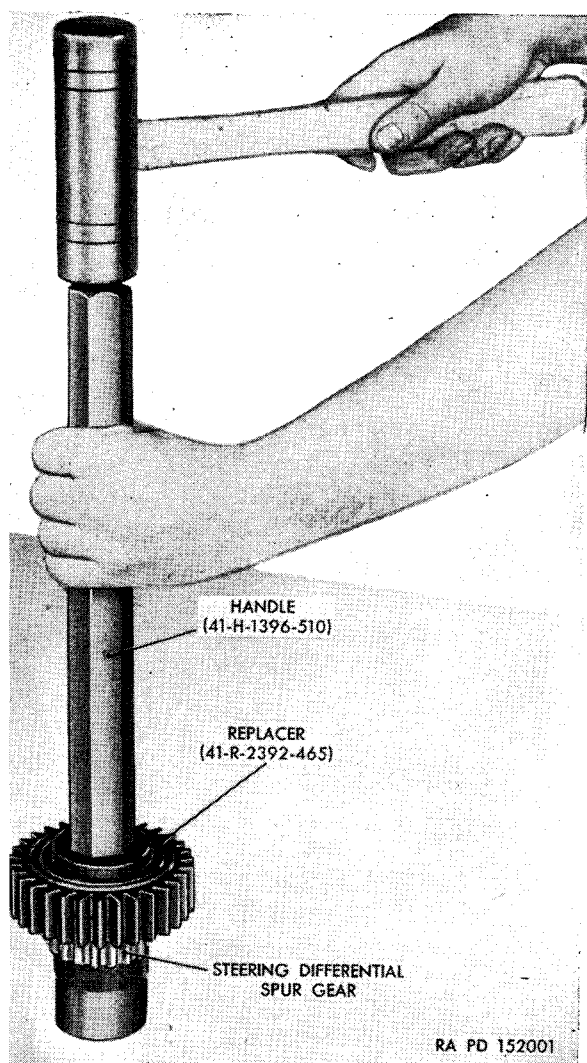


Figure 262. Installing spur-gear ball bearing.

- retaining snap ring in the cage using a screwdriver. Heat the bearing and cage assembly and install it, snap ring side down, on the left-steering shaft (fig. 274).
- (8) Install the gear on the shaft so that the gear's longest shoulder is against the ball bearing. Install the tabbed lock washer and lock nut. Tighten the lock nut to 300 pound-feet, using spanner wrench (41-W-640-315) (fig. 272) and bend a tab of the washer into the nut to secure it.
 - (9) Inspect the right steering shaft, bearing support, bearing, gear, split-spacer, and splined spacer. Install the bearing in the support. Install the bearing-retain-

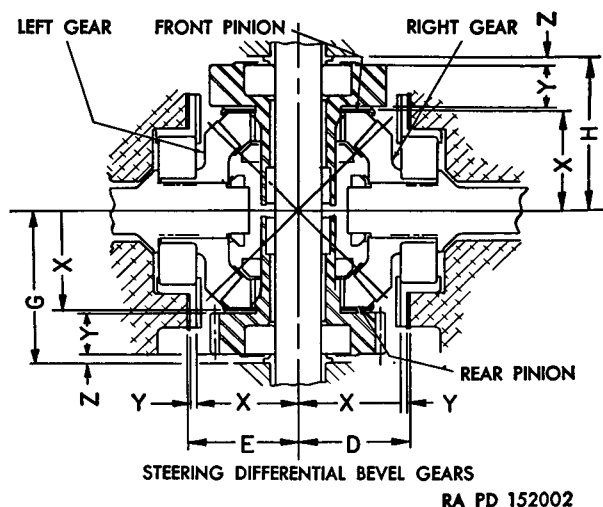


Figure 263. Steering differential inspection chart.

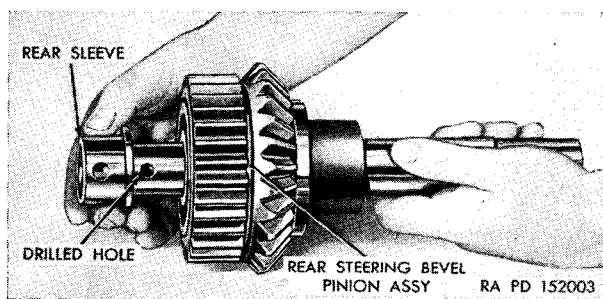


Figure 264. Installing rear sleeve.

- ing snap ring using a screwdriver. Press the bearing assembly, snap ring side up, onto the hub of the right steering-shaft gear (fig. 275).
- (10) Support the right steering shaft on wood blocks and install the left steering shaft assembly over the right steering shaft (fig. 276). Install the split spacer on the right steering shaft (fig. 270). Install the gear and bearing assembly on the right steering shaft (fig. 277). Install the splined spacer so that the lock screw hole in the spacer is aligned with the punch mark on the end of the shaft.
 - (11) Install the lock nut, and using the spanner wrench (41-W-640-305), tighten the nut to 350 pound-feet. Torque further if necessary, to align the lock screw hole in the lock nut with the lock screw hole in the spacer. Install and tighten the lock screw and stake it to the lock nut.

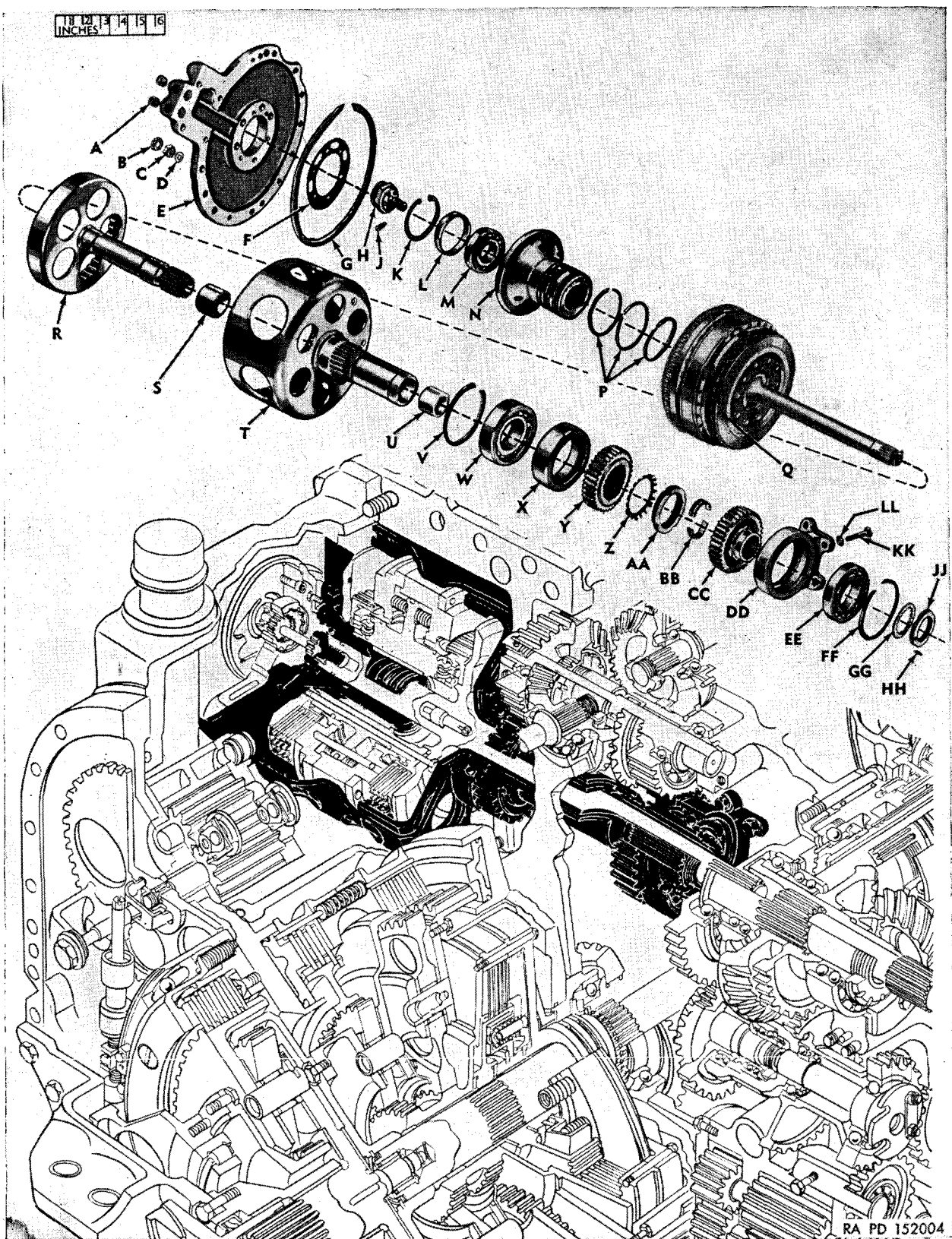


Figure 265. Left and right steering shafts, oil transfer sleeve, and rear cover plate assemblies—exploded view.

A—PLUG (2) GM-444699
 B—JAM NUT (18) GM-107322
 C—NUT (18) GM-103026
 D—WASHER (18) GM-103341
 E—TRANSMISSION REAR COVER GM-6765380
 F—GASKET GM-6765381
 G—SNAP RING GM-6760312
 H—LOCK SCREW GM-6765370
 J—SCREW GM-102818
 K—SNAP RING GM-6760199
 L—SPACER GM-6765371
 M—BEARING GM-903207
 N—OIL TRANSFER SLEEVE GM-6765430
 P—SEAL RING (3) GM-6765367
 Q—STEERING CLUTCH ASSEMBLY GM-6765398
 R—RIGHT STEERING SHAFT GM-6763993
 S—BUSHING GM-6764030
 T—LEFT STEERING SHAFT GM-6764024
 U—BUSHING GM-6764030
 V—SNAP RING GM-8892840
 W—LEFT STEERING SHAFT BEARING GM-903014
 X—BEARING CAGE GM-6760167
 Y—LEFT STEERING SHAFT GEAR GM-6765326
 Z—LOCK WASHER GM-127693
 AA—LOCK NUT GM-127716
 BB—SPLIT SPACER GM-6760319
 CC—RIGHT STEERING SHAFT GEAR GM-6765331
 DD—RIGHT STEERING SHAFT BEARING SUPPORT GM-6760188
 EE—RIGHT STEERING SHAFT BEARING GM-903211
 FF—SNAP RING GM-6760289
 GG—SPACER GM-6760341
 HH—LOCK SCREW GM-222890
 JJ—RIGHT STEERING SHAFT BEARING NUT GM-6760342
 KK—BOLT (4) GM-192905
 LL—WASHER (4) GM-103342

Figure 265—Continued.

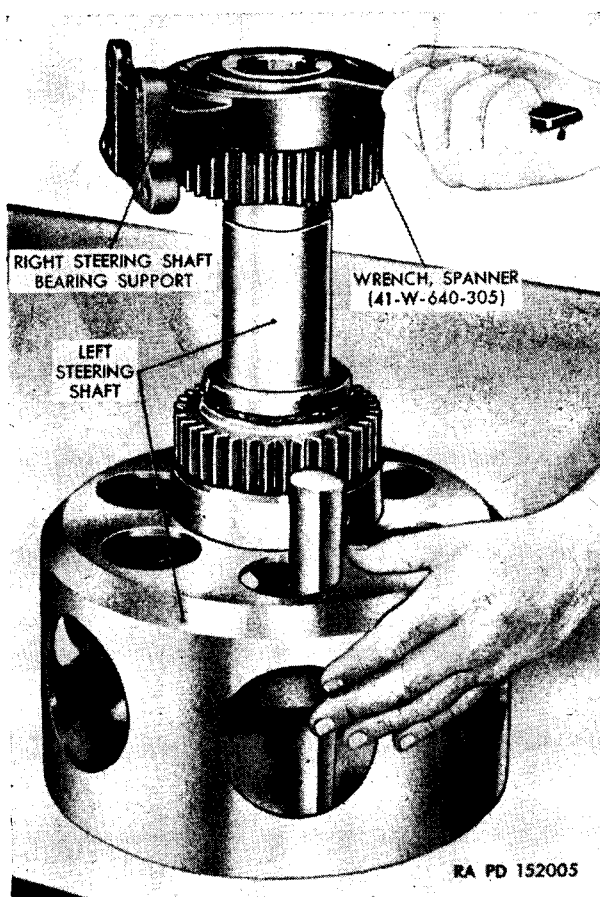


Figure 266. Removing right steering-shaft bearing nut.

d. LEFT STEERING CROSS-SHAFT AND BEARING ASSEMBLY AND BEARING CAGE (fig. 258).

- (1) Inspect the left steering cross-shaft and bearing assembly for defects in the gear, bearing or shaft. If disassembly is necessary, bend back the tab on the lock washer. Using spanner wrench (41-W-3736-280), remove the lock nut (fig. 278). Remove the tabbed lock washer, and the bevel-gear and bearing assembly. Press the gear out of the bearing and remove the bearing retainer.
- (2) Inspect the left steering cross-shaft bearing cage.

Note. If inspection shows the bevel gear to be defective or if any of the other three steering bevel gears has been replaced, it will be necessary to replace the gears. The two steering-differential bevel gear, the right steering cross-shaft bevel gear, and the left steering cross-shaft bevel gear are a matched set of gears. If one gear is defective the entire set must be replaced.

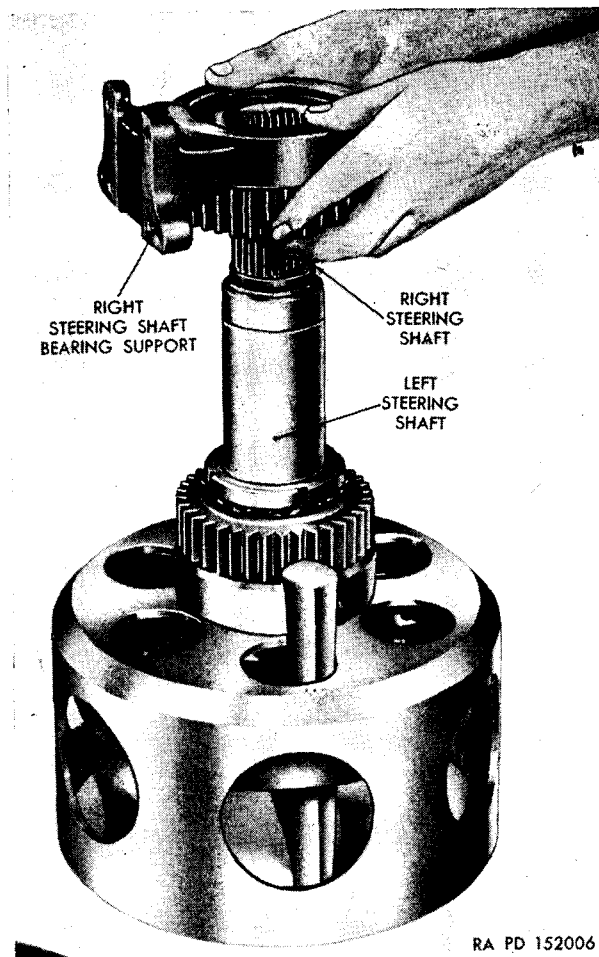


Figure 267. Removing right steering-shaft gear and bearing assembly.

- Refer to figure 263 and *b* (7) through (9) above.
- (3) If the gear or the bearing cage has not been replaced, refer to (4) below for the assembly of the left steering cross-shaft. If it is necessary to determine the nominal shim, measure and record the thickness of the bearing-cage flange. This measurement is dimension *Y*. Add the gear mounting distance, dimension *X*, which is stamped on the gear, to the dimension *Y*. Subtract (*X*+*Y*) from the dimension *E* which is given on the left housing. The result will be the nominal shim pack required. The formula is $E - (X + Y) = \text{Shim}$.
 - (4) Wire the shim pack to the bearing cage for safekeeping.

Note. If a new shim pack has been made up according to (3) above, dispose of the

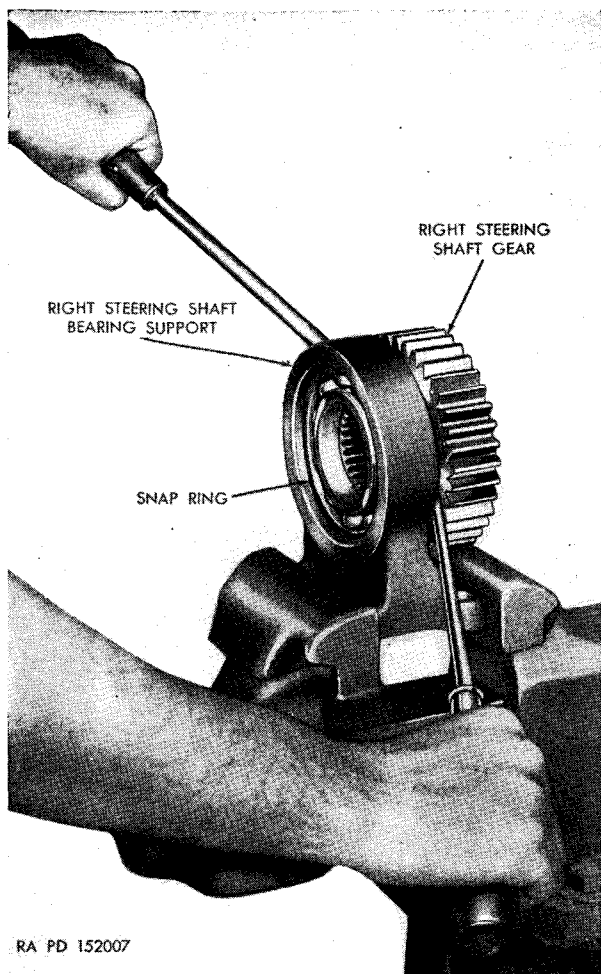


Figure 268. Removing right steering-shaft gear.

original shim pack to avoid any possibility of using it in the place of the new ship pack.

To assemble the left steering cross-shaft, install the bearing retainer over the gear hub and press the bearing onto the gear hub. Be sure that the lettered side of the bearing is installed toward the bearing retainer.

- (5) Install the gear and bearing assembly on the left steering cross-shaft. Install the tabbed lock washer and lock nut on the shaft. Tighten the nut with spanner wrench (41-W-3736-280) (fig. 278). Bend the tab of the lock washer over to secure the lock nut.

e. FAN- AND PUMP-DRIVE SHAFT AND PINION (fig. 279).

- (1) Inspect the fan- and pump-drive shaft. Inspect the fan- and pump-drive pinion

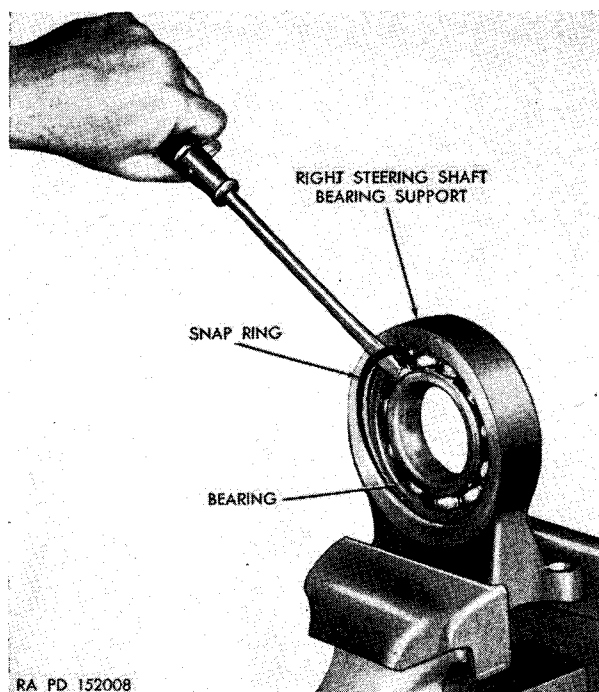


Figure 269. Removing bearing-retaining snap ring.

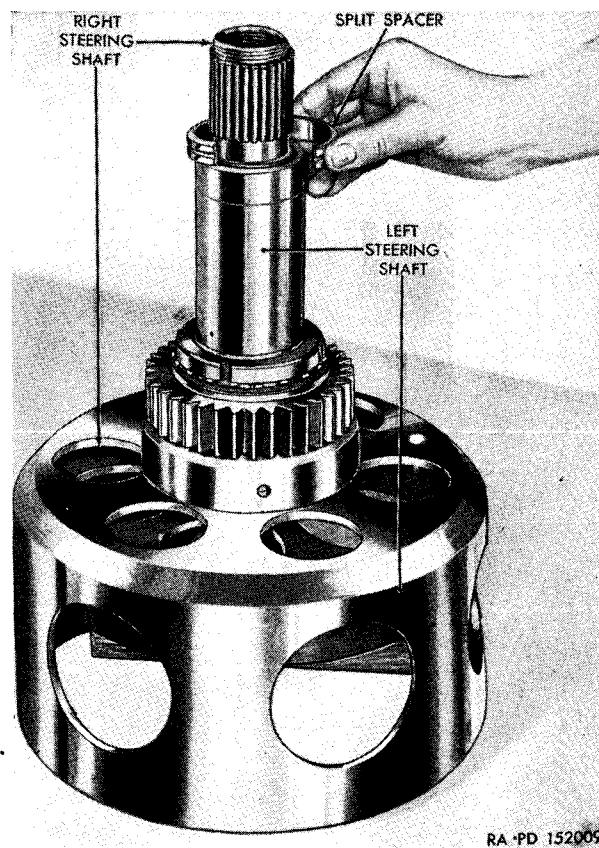


Figure 270. Removing or installing split-spacer.

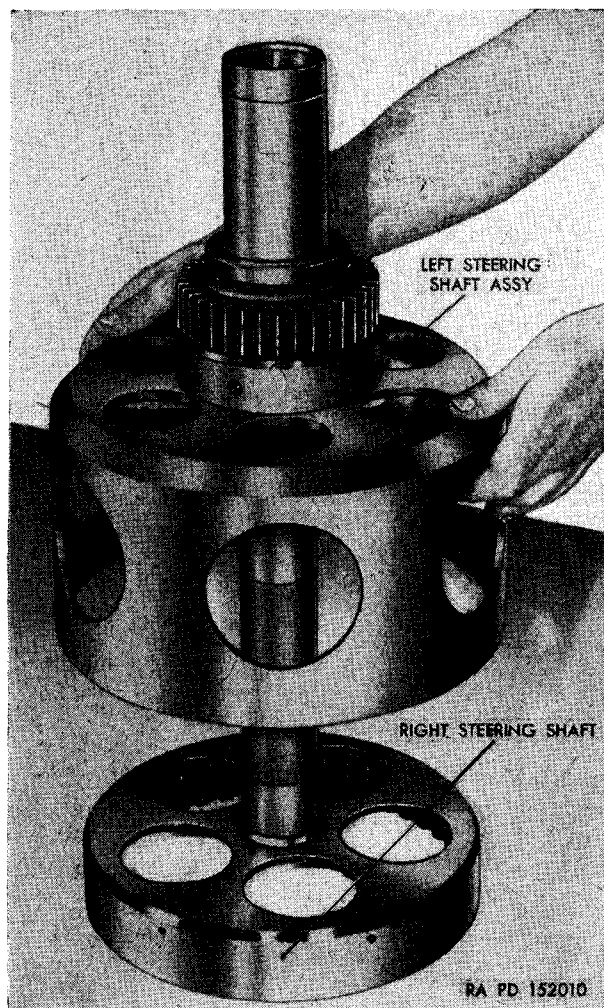


Figure 271. Removing left steering shaft.

- and bearings. If it is necessary, remove the ball bearing from the small end of the gear by using a drift, being careful not to drive on the balls or on the inner race. After the bearing has been removed from the small end of the gear, remove the bearing from the large end of the gear if necessary, by using replacer and remover (41-R-2373-862) and handle (41-H-1396-510).
- (2) To replace the bearing in the large end of the gear, use an arbor press or the handle (41-H-1396-510) and the remover and replacer (41-R-2373-862) (fig. 280). Install the bearing with the lettered side out. Install the other bearing, lettered side out, in the small end of the gear, using replacer (41-R-2382-550) and handle (41-H-1396-510) (fig. 281).

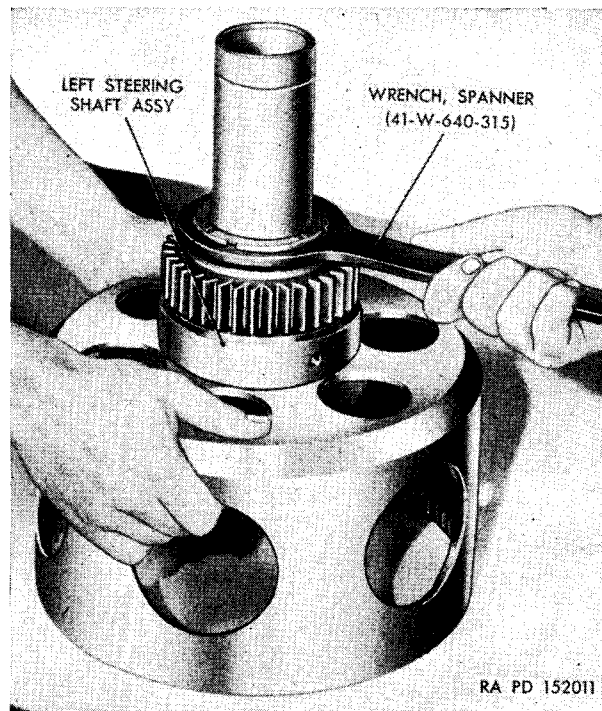


Figure 272. Removing or installing left steering-shaft lock nut.

f. INPUT GEARING ASSEMBLY (fig. 279).

- (1) Inspect the converter-output-driven bevel pinion and the transfer driving gear. Inspect the transfer driven gear, input-driving bevel gear and fan-drive gear. Inspect the bearings for roughness of rotation. Inspect the input shaft coupling. If disassembly is necessary, use a screwdriver to remove the lock screw which retains the converter-output-driven bevel pinion and transfer-gear assembly (fig. 282).
- (2) Set the input gearing assembly on a wood block, and tapping lightly with a drift and hammer on the end of the converter output bevel pinion and transfer gear assembly, remove it from the center bearing support (fig. 283). Inspect the bearings. If further disassembly is necessary, use a $\frac{3}{8}$ -inch hex wrench to remove the lock screw from the lock nut on the end of the converter-output bevel pinion.
- (3) Place the pinion assembly in a vise, and using spanner wrench (B7083777), (fig. 284) and a $\frac{3}{4}$ -inch drive break-over bar, remove the lock nut and lock washer. Using a gear puller attached to the spacer



Figure 273. Removing bearing and cage assembly.

under the double row ball bearing, pull the bearing and spacer from the converter output bevel pinion (fig. 285).

Note. Do not attempt to remove the roller bearing unless it has failed, in which case the bearing may be pried off the bevel pinion and a new bearing pressed on.

- (4) If the converter-output-driven bevel pinion or the transfer-driving gear has failed, replace the bevel pinion, transfer driving gear, and roller bearing as an assembly.

Note. If the converter-output-driven bevel pinion is replaced, it is necessary to replace the converter-output-driving bevel gear because these two gears comprise a matched set.

Refer to (17) through (19) below for assembly.

- (5) Remove the input-shaft lock nut using spanner wrench (41-W-544-100) (fig. 286). This nut was loosened during the disassembly of the left housing. Using a gear puller, remove the input-driving bevel gear, fan-drive gear, and front bearing assembly from the input shaft (fig. 287). Inspect the front bearing assembly. If further disassembly is necessary, use a ½-inch socket to remove the four bolts from the front bearing support. Remove the retainer.

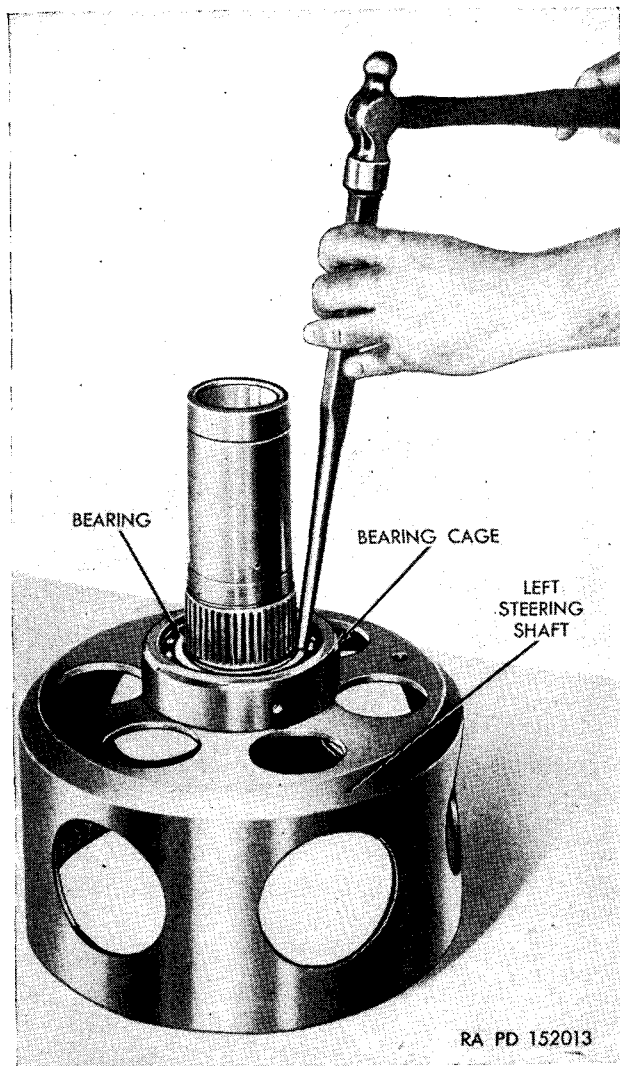


Figure 274. Installing bearing and cage assembly.

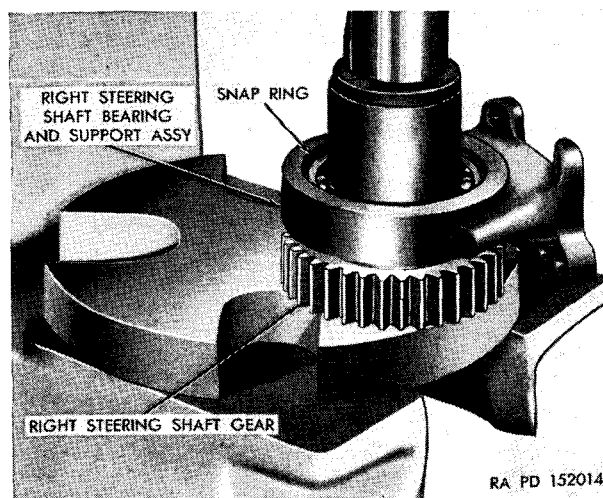


Figure 275. Installing right steering-shaft bearing assembly.

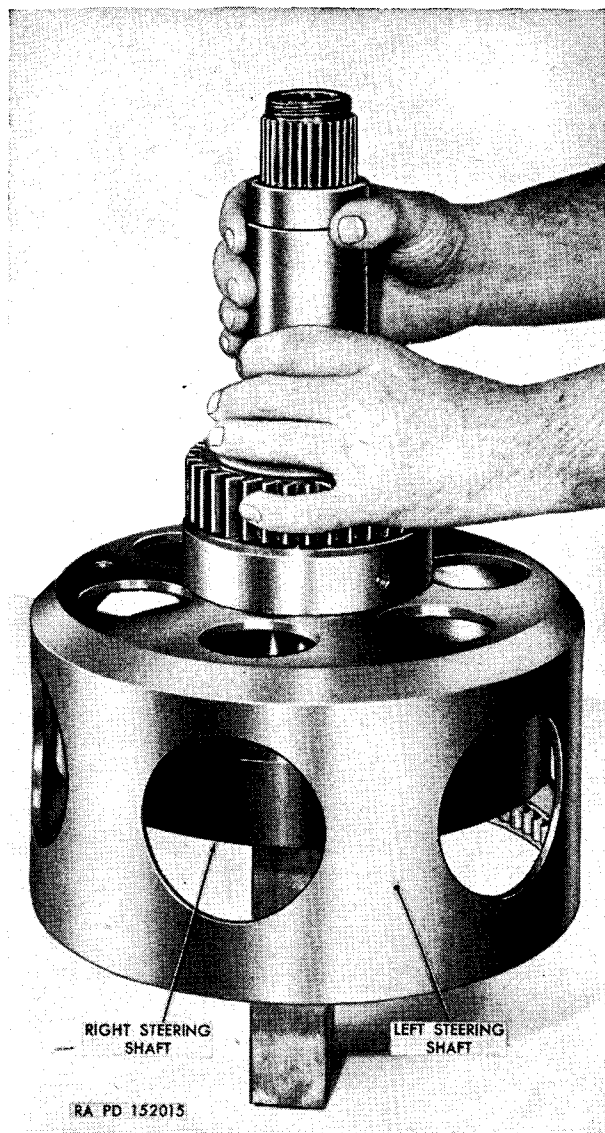


Figure 276. Installing left steering shaft.

- (6) Separate the bearing cage from the front bearing support by using two of the bolts removed from the support as jack screws (fig. 288). Remove the bearing cage and bearing assembly from the support. Remove the shims and wire them to the support for safekeeping. Press the bearing from the cage. Lift the center-bearing support off the center bearing (fig. 289).
- (7) Inspect the center bearing, rear bearing, and transfer-driven gear. If further disassembly is necessary, remove the center bearing from the input shaft using a gear

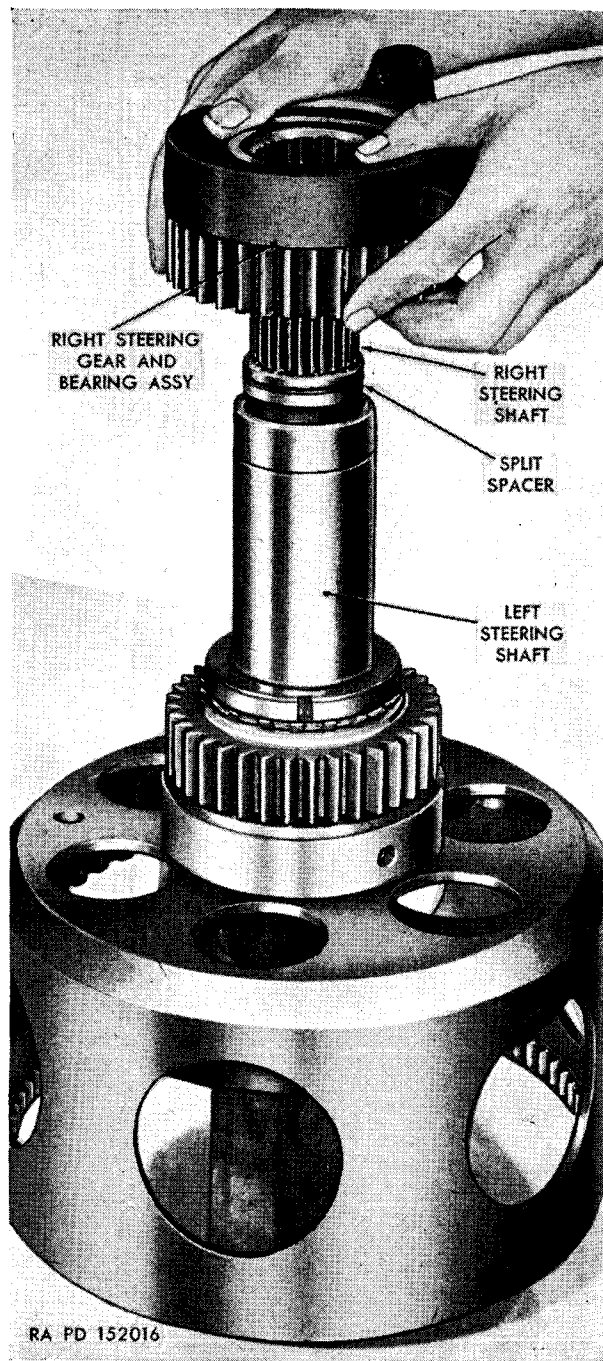


Figure 277. Installing right steering-shaft gear and bearing assembly.

- puller (fig. 290) and then remove the spacer. Remove the snap ring from the converter-output-transfer driven gear using a screwdriver (fig. 291).
- (8) Turn the assembly over and support the transfer gear on wood blocks. Using a hammer and drift through the holes in

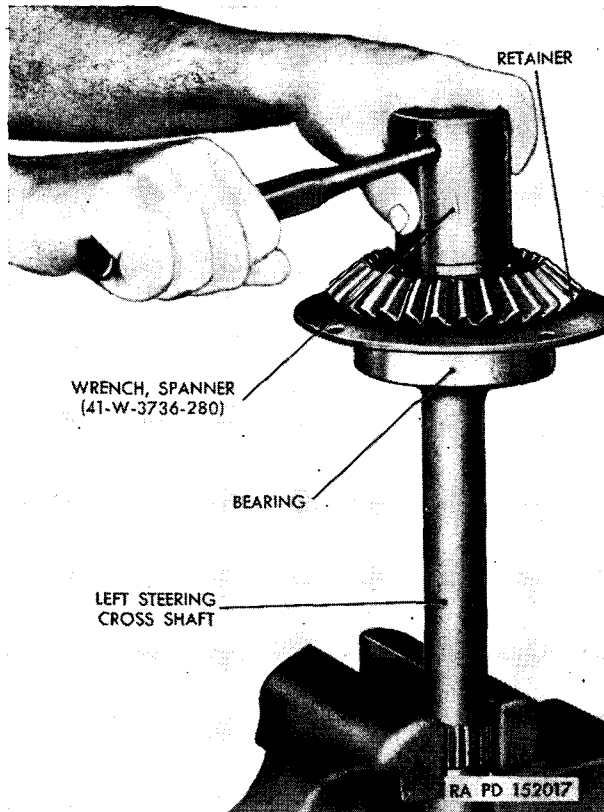


Figure 278. Removing or installing left steering cross-shaft lock nut.

the gear, drive the input shaft and rear bearing out of the gear (fig. 292). If the rear bearing or the input shaft is defective, press the shaft out of the bearing using an arbor press.

- (9) Inspect the input shaft. Do not remove the locating snap ring from the inside of the shaft unless it is defective. Carefully inspect all the other parts of the input shaft assembly. To assemble the input shaft, install the rear bearing, if removed, on the input shaft using an arbor press to seat it against the shoulder on the shaft. The lettered side of the bearing should be away from the shoulder.
- (10) Install the spacer and the center bearing using an arbor press to seat the bearing (fig. 293). Install the input shaft and rear bearing assembly in the transfer driven gear using a drift or an arbor press on the bearing outer race (fig. 294).
- (11) Install the snap ring in the gear (fig. 291). Install the center-bearing support on the center bearing (fig. 289).

Note. If a new driving bevel gear is being installed, or if any other new parts which might affect the bevel gear adjustment are being installed, it is necessary to measure and record the distance between the thrust face on the rear hub of the input driving bevel gear and the machined surface on the back of the gear (fig. 295). This measurement, known as the step measurement, will be used in calculating the nominal shim pack in (14) below. If the original parts are to be used, this measurement is unnecessary.

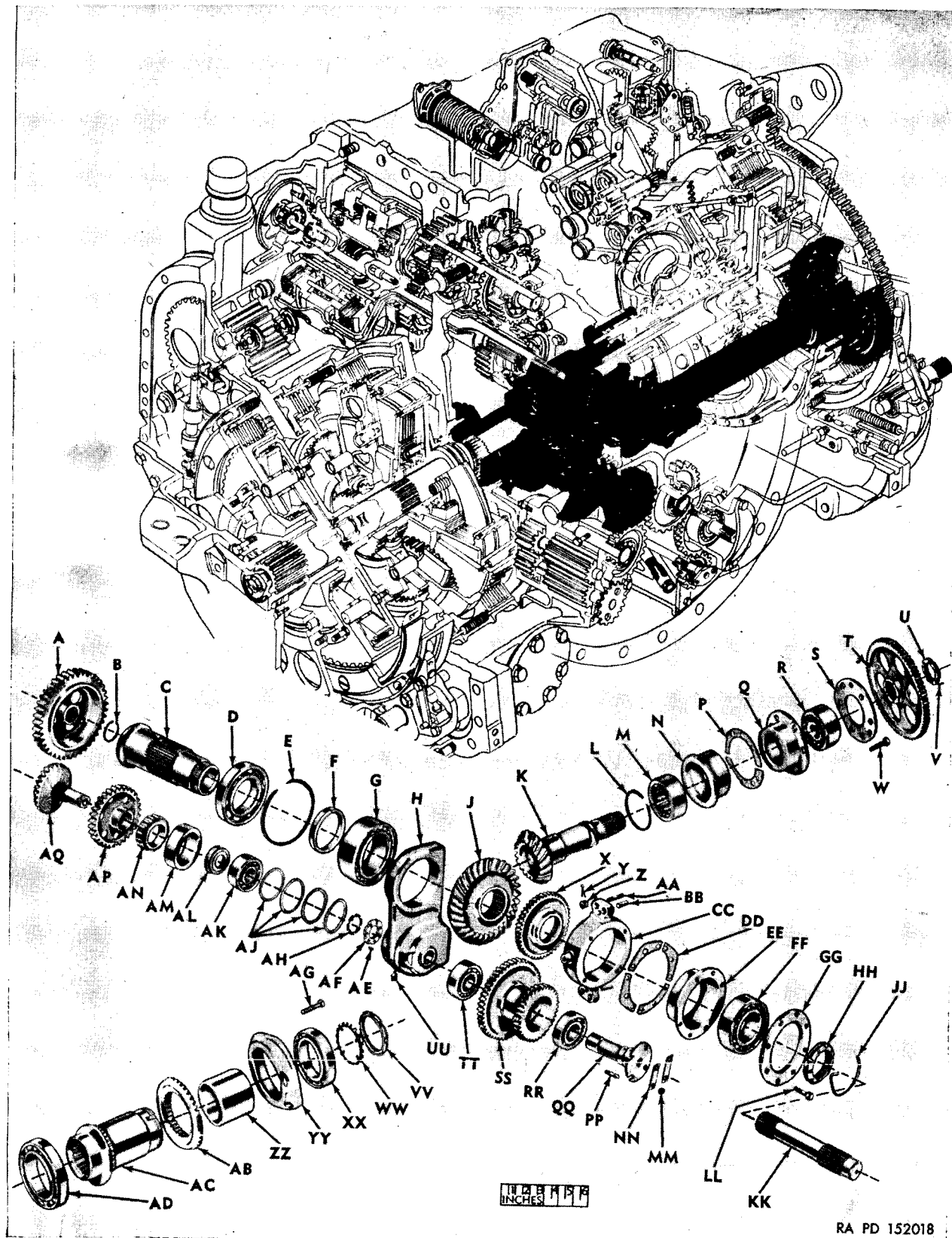
- (12) Install the input driving bevel gear on the input shaft (fig. 296). Install the the fan- and pump-drive gear on the input shaft (fig. 297). Using an arbor press, install the front bearing in the bearing cage if the bearing has been removed. Install the bearing cage in the front-bearing support, being careful to line up the bolt holes.

Note. If the original shims are to be used, install them behind the bearing cage before seating the cage in the support.

- (13) Install the bearing retainer and secure it to the bearing cage with four $\frac{5}{16}$ -inch bolts. Torque the bolts 15 to 18 pound-feet. Install the front bearing and cage assembly on the input shaft using an arbor press (fig. 298). Install and tighten the lock nut (fig. 286).

Note. The lock nut will be torqued to 350 pound-feet during the assembly of the left housing. The lock ring will be installed on the nut at that time.

- (14) When it is necessary to determine the nominal shims (fig. 299), begin by setting up the input shaft assembly on a surface plate. Measure and record distance from the machined surface on the back of the bevel gear to the front face of the bearing retainer (fig. 300). To this measurement add the step measurement recorded in (11) above.
- (15) Measure and record the distance from the face of the bearing retainer to the machined front surface of the bearing support (fig. 301). Subtract the last measurement from the sum of the first two measurements. Label the result (Z). Add the dimension X, which is etched on the bevel gear, to the dimension J, which is stamped on the left housing. Label this sum (X+J). Subtract (X+J)



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Figure 279. Input and converter gearing—exploded view.

A—CONVERTER OUTPUT TRANSFER DRIVEN GEAR GM-6765330
 B—SNAP RING GM-6762787
 C—INPUT SHAFT (COUPLING) GM-6764959
 D—REAR BEARING GM-903214
 E—SNAP RING GM-6764963
 F—SPACER GM-6764962
 G—CENTER BEARING GM-905014
 H—CENTER BEARING SUPPORT GM-6760162
 J—INPUT DRIVING BEVEL GEAR GM-6704178
 K—INPUT DRIVEN BEVEL GEAR GM-6764199
 L—SNAP RING GM-8892840
 M—BEARING GM-7450191
 N—BEARING CAGE GM-6764195
 P—SHIM (2) GM-6764503
 Q—BEARING CAGE GM-6764514
 R—BEARING GM-954502
 S—RETAINER GM-6764198
 T—CONVERTER DRIVE GEAR GM-6764501—1.3 ratio GM-6764502—1.4 ratio
 U—LOCK NUT GM-6764543
 V—SCREW GM-222890
 W—BOLT (6) GM-192353
 X—FAN DRIVE GEAR GM-6760134
 Y—COTTER PIN (4) GM-108629
 Z—NUT (4) GM-119254
 AA—STUD (4) GM-6760183
 BB—DOWEL (2) GM-141244
 CC—FRONT BEARING SUPPORT GM-6760133
 DD—SHIM (4) GM-6760170
 EE—BEARING CAGE GM-6760131
 FF—FRONT BEARING GM-905212
 GG—BEARING RETAINER GM-6760099
 HH—LOCK NUT GM-6700558
 JJ—LOCK RING GM-6700354
 KK—INPUT SHAFT (FROM ENGINE) GM-6760132
 LL—BOLT (4) GM-192347
 MM—NUT (4) GM-103025
 NN—PLATE (2) GM-6760159
 PP—STUD (4) GM-6760149
 QQ—FAN AND PUMP DRIVE SHAFT GM-6704415
 RR—BEARING GM-903207
 SS—FAN AND PUMP DRIVE PINION GM-6704420
 TT—BEARING GM-903206
 UU—LOCK SCREW GM-6760022
 VV—LOCK NUT GM-6760027
 WW—TABBED LOCK WASHER GM-6764983
 XX—LEFT BEARING GM-903018
 YY—LEFT BEARING RETAINER GM-6760354
 ZZ—CONVERTER OUTPUT SHAFT SPACER GM-6760031
 AB—CONVERTER OUTPUT SHAFT DRIVING BEVEL GEAR GM-6760033
 AC—CONVERTER OUTPUT SHAFT GM-6763701
 AD—RIGHT BEARING GM-903018
 AE—SCREW GM-141026
 AF—LOCK NUT GM-6765682
 AG—BOLT (2) GM-6760395
 AH—LOCK WASHER GM-6765421
 AJ—SHIMS GM-6760171, GM-6760172, GM-6760173
 AK—BALL BEARING GM-954533
 AL—SPACER GM-6765420
 AM—BEARING (OUTER RACE) GM-7450165
 AN—BEARING (INNER RACE AND ROLLER) GM-7450165
 AP—TRANSFER DRIVING GEAR GM-6765329
 AQ—CONVERTER OUTPUT DRIVEN BEVEL PINION GM-6760018

Figure 279—Continued.

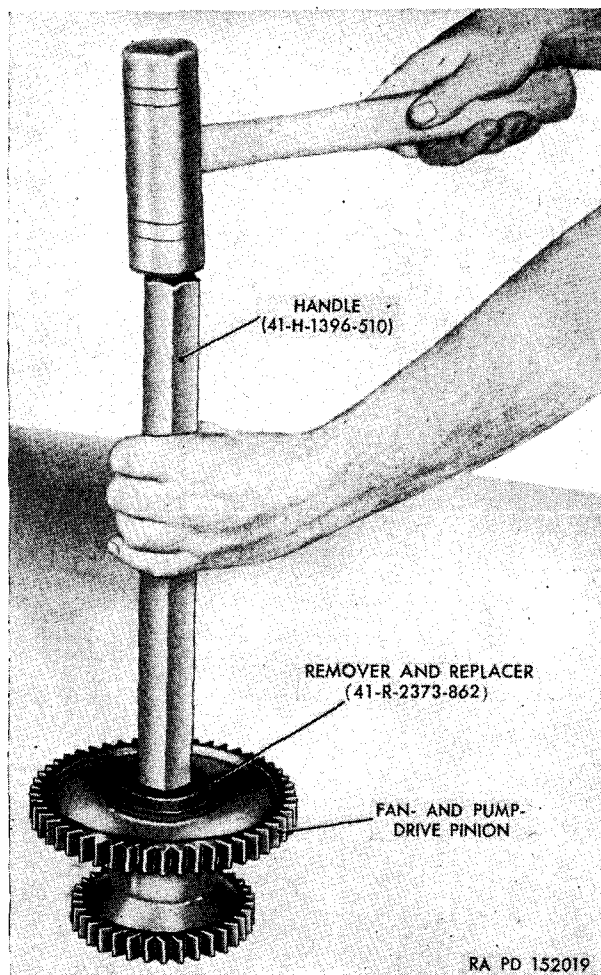


Figure 280. Installing bearing in large end of fan and pump pinion.

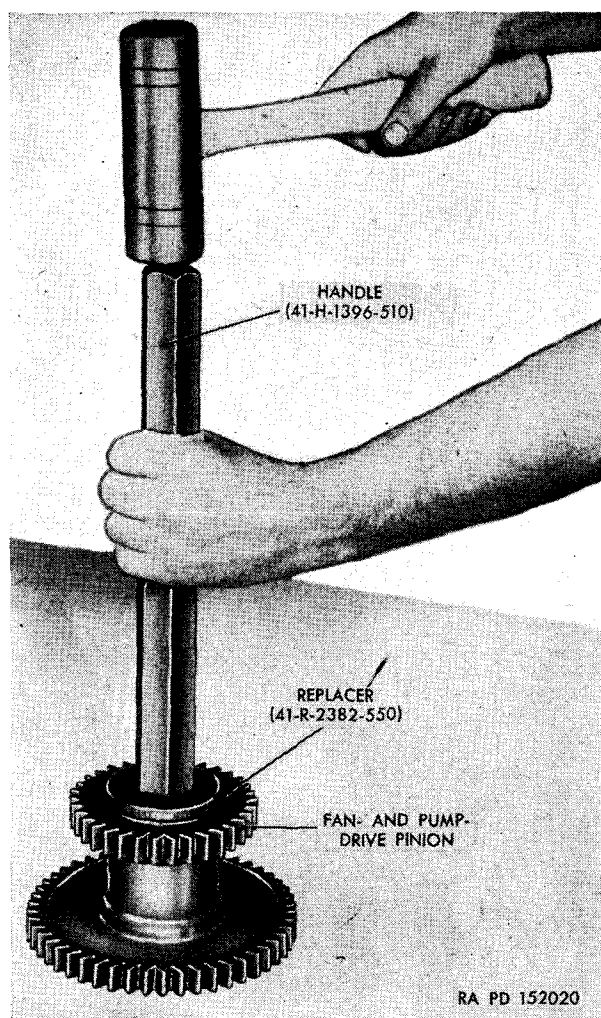


Figure 281. Installing bearing in small end of fan and pump pinion.

from (Z). The result is the nominal shim thickness. The formula is $(Z) - (X + J) = \text{Shims}$.

- (16) Remove the four bolts from the bearing retainer and remove the retainer. Using two of the retainer bolts as jack screws, pull the bearing cage out of the support far enough to permit the installation of the shims between the cage and the front bearing support (fig. 302). Install the bearing retainer and bolts.
- (17) Inspect the converter-output bevel pinion and transfer spur gear assembly. Inspect the roller bearing and ball bearing. Assemble the roller bearing to the bevel and spur gear assembly, the lettered side away from the gear, being careful to drive or press only on the bearing inner race.

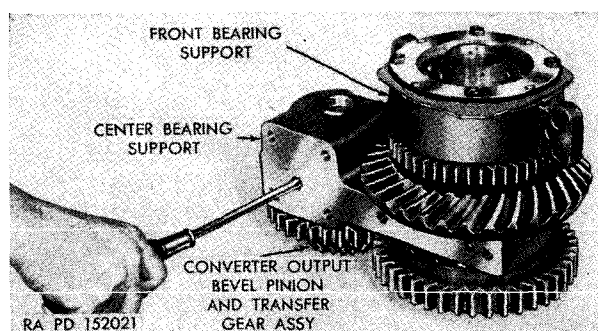


Figure 282. Removing or installing lock screw.

- (18) Install the spacer with its largest OD next to the bearing. Install the double-row ball bearing, lettered side out, and seat it using an arbor press or drift (fig. 303). Install the lock washer and lock

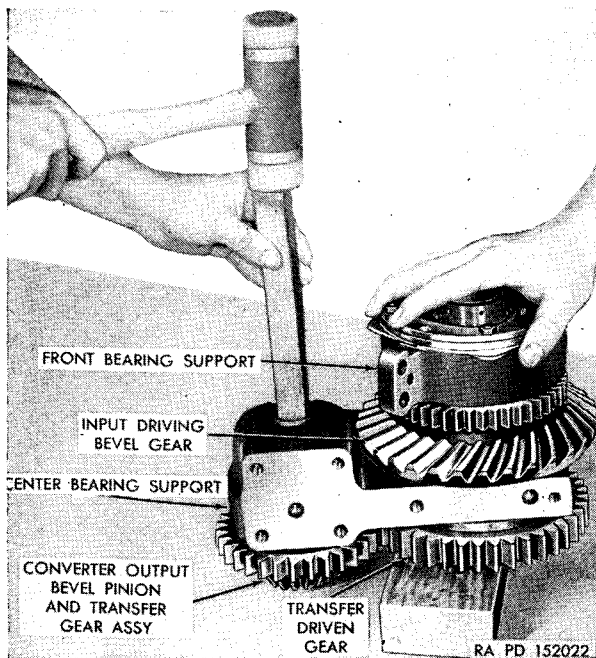


Figure 283. Removing converter-output bevel pinion and transfer gear assembly.

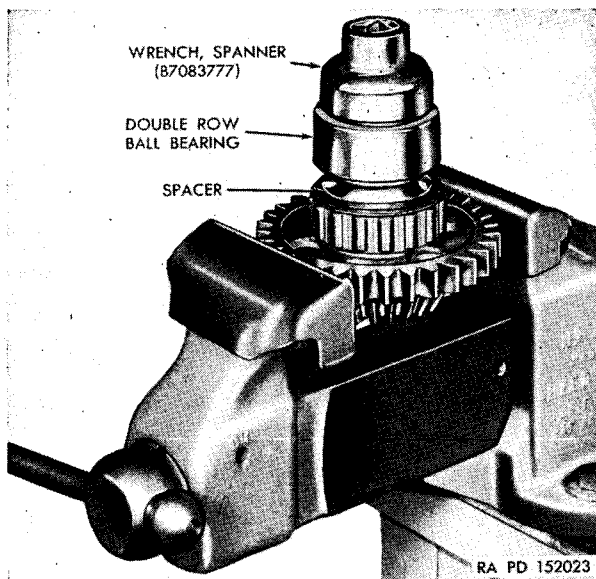


Figure 284. Spanner wrench (B7083777) installed on converter-output-bevel-pinion lock nut.

nut. Torque the nut to 200 pound-feet using the spanner wrench (B7083777) (fig. 284). Continue to tighten the nut until one of the holes in the nut is aligned with one of the holes in the lock washer.

- (19) Install the lock screw in the holes and tighten it. Stake the lock screw to the

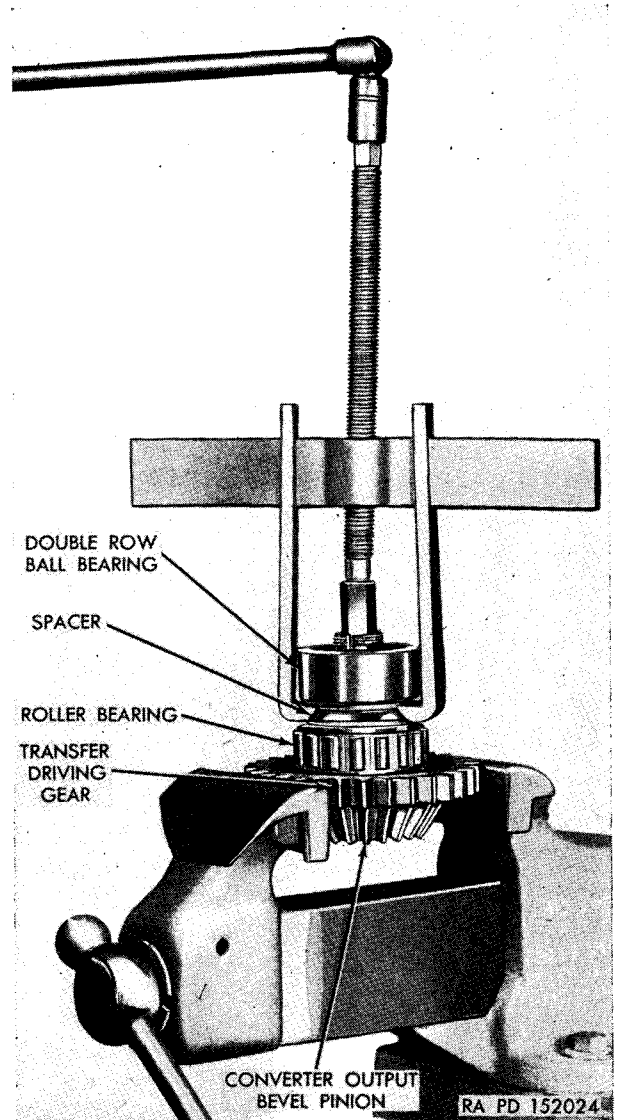


Figure 285. Removing bevel-pinion bearing and spacer.

lock nut. Install the proper shim pack in the center-bearing support.

Note. If a new converter-output-driven pinion or any other new part has been installed in the driven pinion assembly, follow the procedure given in (20) and (21) below to determine the proper nominal shim pack.

Install the converter-output bevel pinion and transfer gear assembly in its support. Secure the assembly by installing a lock screw in the support (fig. 282).

- (20) If it is necessary to determine the nominal shim pack for the converter-output bevel pinion, refer to figure 304 and *b* (7)

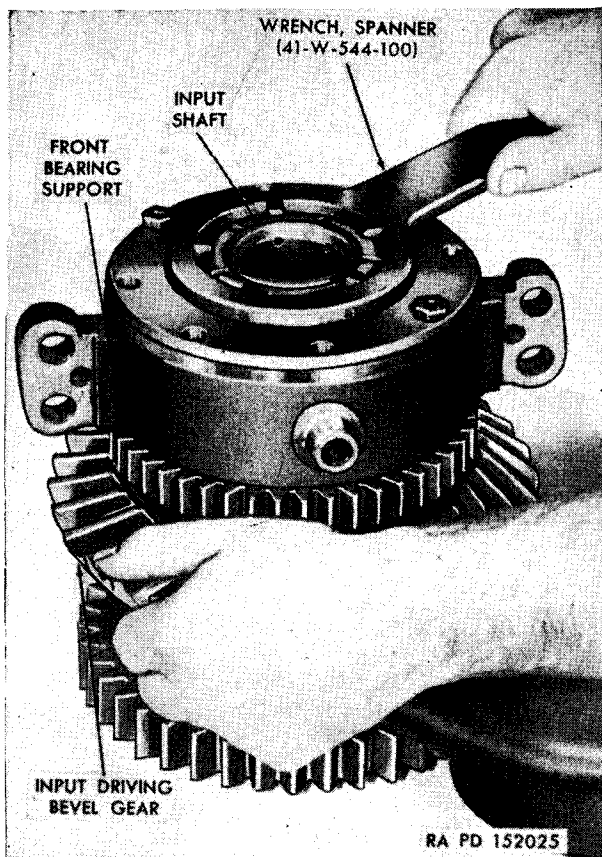


Figure 286. Removing or installing input-shaft lock nut.

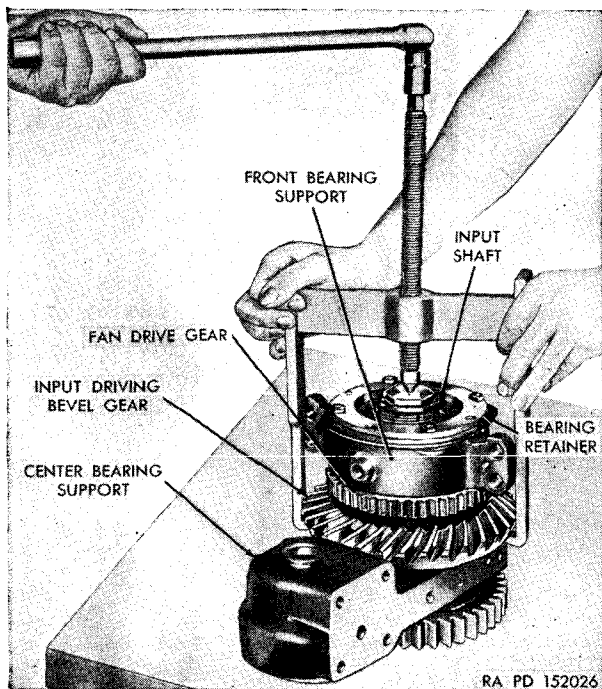


Figure 287. Removing input-driving bevel gear, fan-drive gear and front bearing assembly.

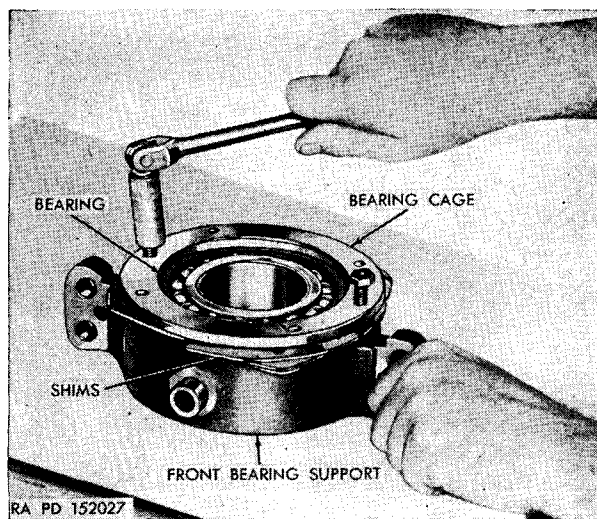


Figure 288. Separating bearing cage from bearing support.

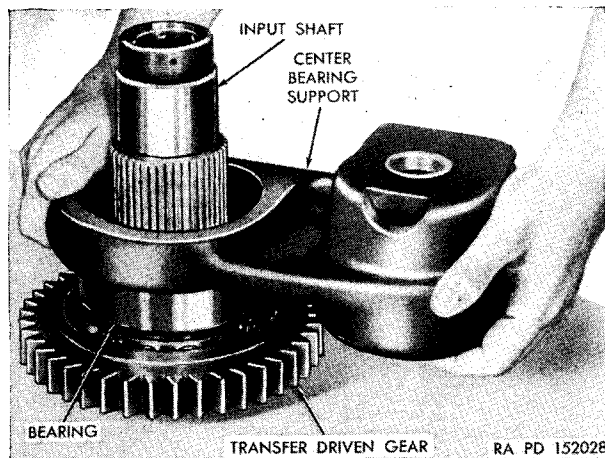


Figure 289. Removing or installing center bearing support.

through (9) above. Record the gear mounting distance, dimension X , which is etched on the gear. With the outer race removed from the roller bearing, measure and record the distance (Y) from the machined surface on the back of the gear to the side of the ball bearing nearest the lock nut. Use a depth micrometer through a hole in the transfer gear to make this measurement (Y).

- (21) Add dimension X to measurement Y . From the housing dimension (B), stamped in the right housing, subtract the sum ($X + Y$). The result is the nominal shim pack thickness. The formula is $B - (X + Y) = \text{Shim}$.

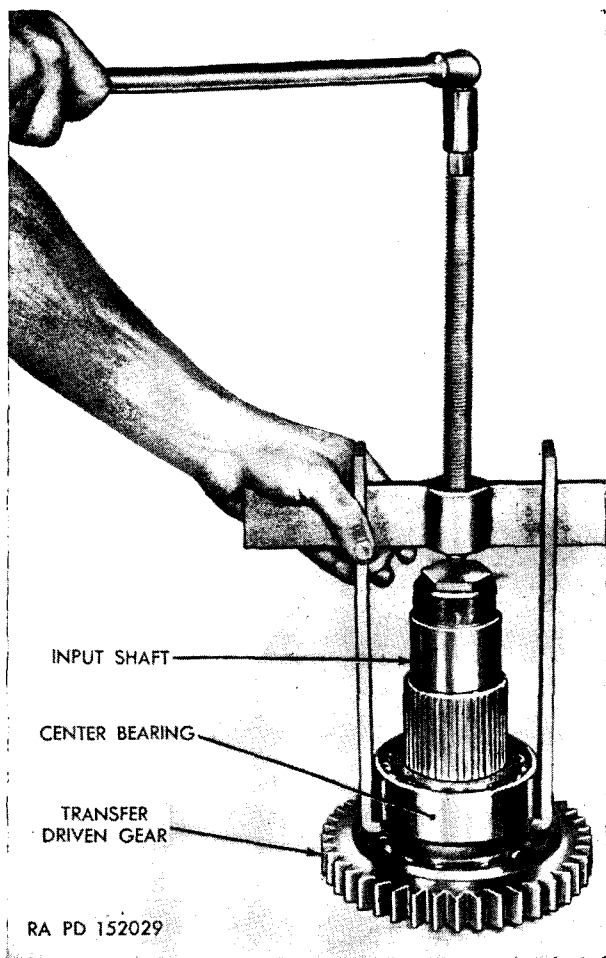


Figure 290. Removing input-shaft center bearing.

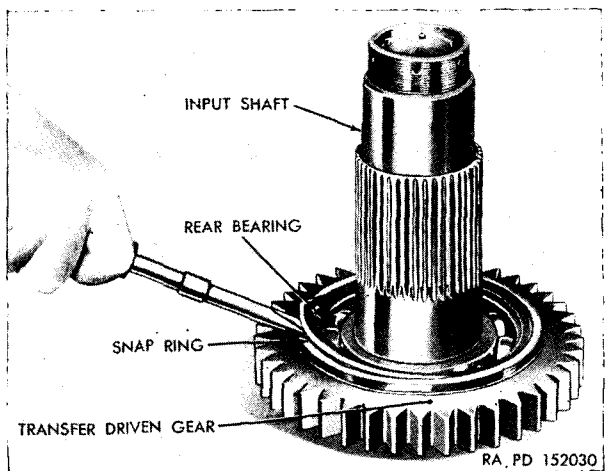


Figure 291. Removing or installing converter-output transfer-driven-gear snap ring.

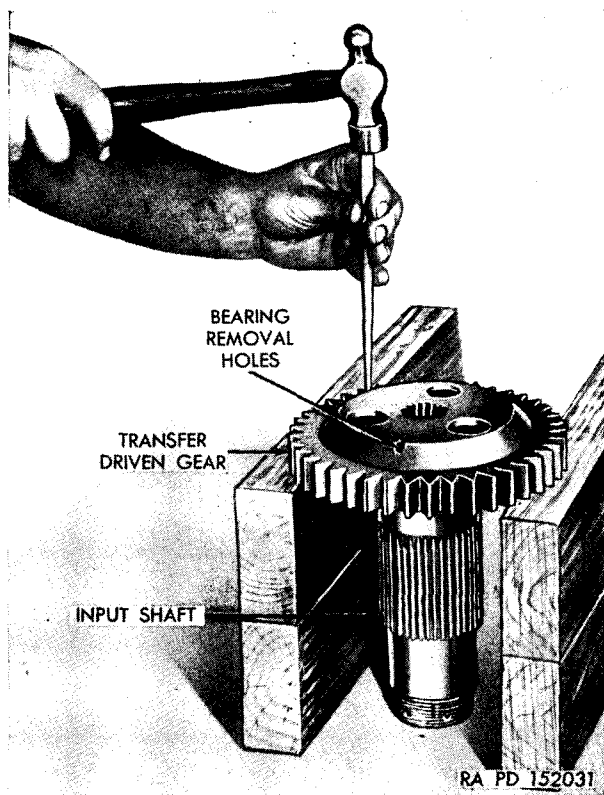


Figure 292. Removing input shaft and rear bearing.

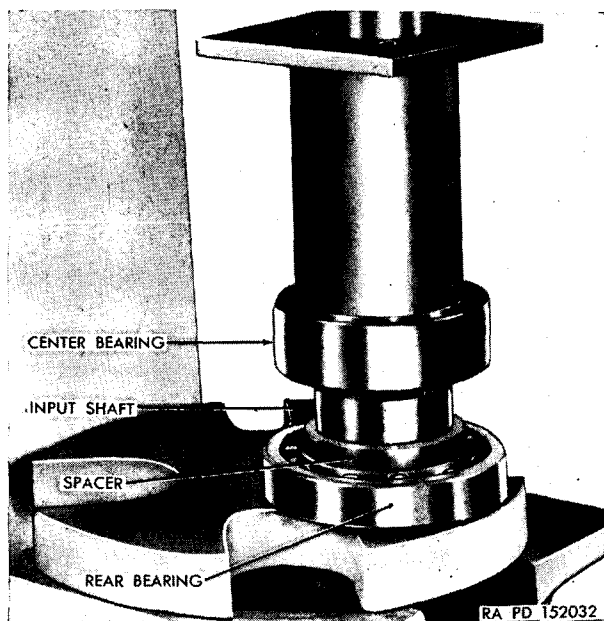


Figure 293. Installing input-shaft-rear bearing.

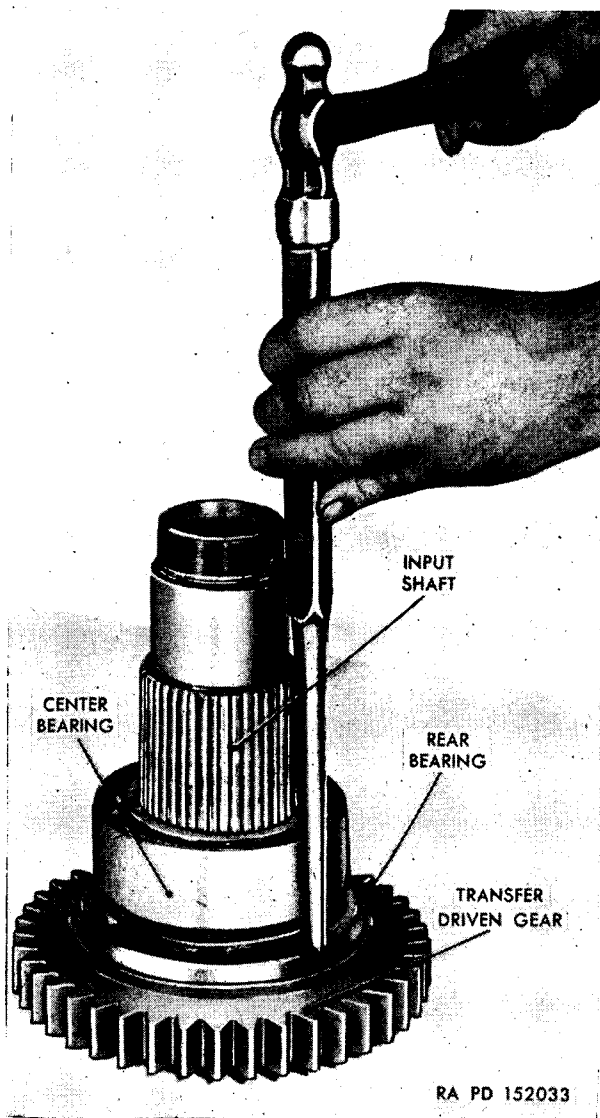


Figure 294. Installing input shaft and rear bearing.

g. CONVERTER-OUTPUT SHAFT, DRIVING BEVEL GEAR, AND GROUND SLEEVE.

- (1) Inspect the converter-output shaft and driving-bevel gear assembly (fig. 279). If inspection indicates that disassembly is necessary, bend down the tabs of the lock washer using a small punch. Using spanner wrench (41-W-640-320), remove the converter-output-shaft lock nut (fig. 305). Remove the tabbed washer.
- (2) Using a gear puller hooked under the bevel gear, remove the gear, spacer, retainer and left bearing (fig. 306). If it is necessary, press the shaft out of the

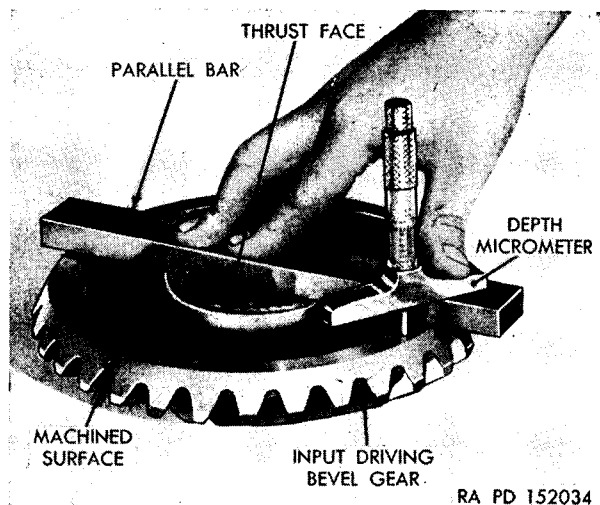


Figure 295. Obtaining step measurement on gear.



Figure 296. Installing input driving bevel gear.

right bearing. Inspect the converter ground sleeve (fig. 175). Replace the hook-type seal ring if it is defective.

Note. Do not attempt to remove the oil transfer sleeve from the ground sleeve. If the transfer sleeve is defective replace the ground sleeve assembly.

- (3) To assemble, install the right bearing on the converter output shaft. Seat the bearing with an arbor press, being careful to press only on the bearing inner race.

Note. If any new parts are being installed in the converter-output shaft assembly or if a



Figure 297. Installing fan and pump drive gear

new converter ground sleeve is to be installed in the housing, it will be necessary to compute a new nominal shim pack for the driving bevel gear. If new shims are to be installed, measure and record the step distance from the thrust face of the bevel gear to the machined surface on the back of the gear. The procedure for computing the nominal shims will be found in (5) through (9) below.

- (4) Install the bevel gear with its thrust face against the flange on the shaft. Install the spacer and the retainer with the bearing bore away from the gear. Install the left bearing, using an arbor press (fig. 307). Install the tabbed lock washer and lock nut using spanner wrench (41-W-640-320). Torque the nut to 400 pound-feet minimum and bend the lock washer tab over to secure the nut.
- (5) To determine the nominal shim pack for the converter-output-driving bevel gear, refer to figure 308 and *b* (7) through (9) above. Place the converter ground sleeve on a surface plate with the bearing bore up. Measure and record the distance from the outside edge of the bearing bore down to the face of the flange which fits against housing.
- (6) Measure and record the distance from the outside edge of the bearing bore to the inside lip of the bearing bore. Sub-

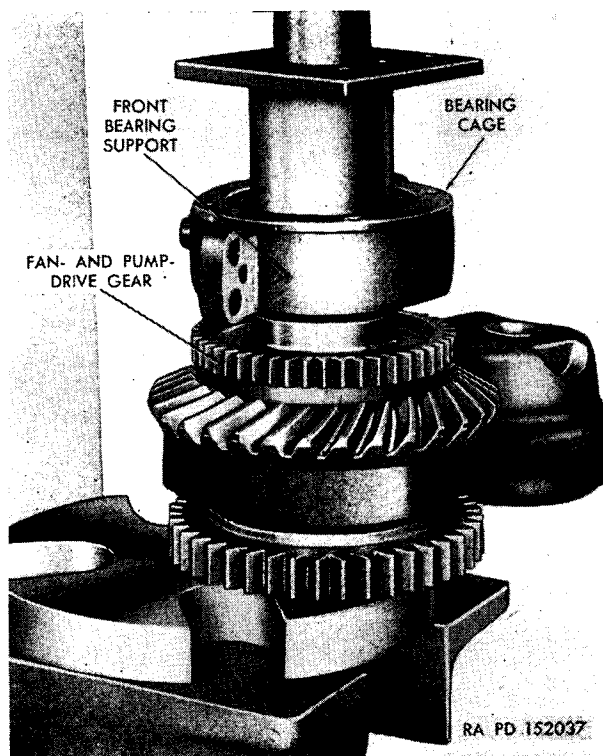


Figure 298. Installing front bearing and cage assembly.

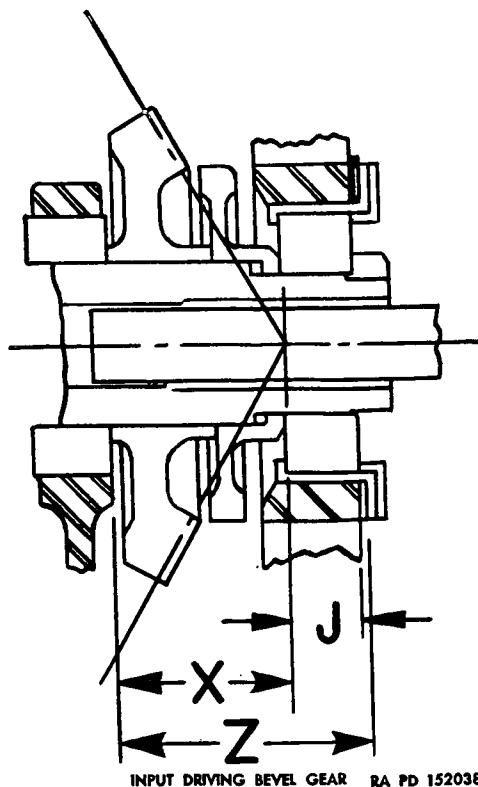


Figure 299. Input driving bevel gear inspection chart.

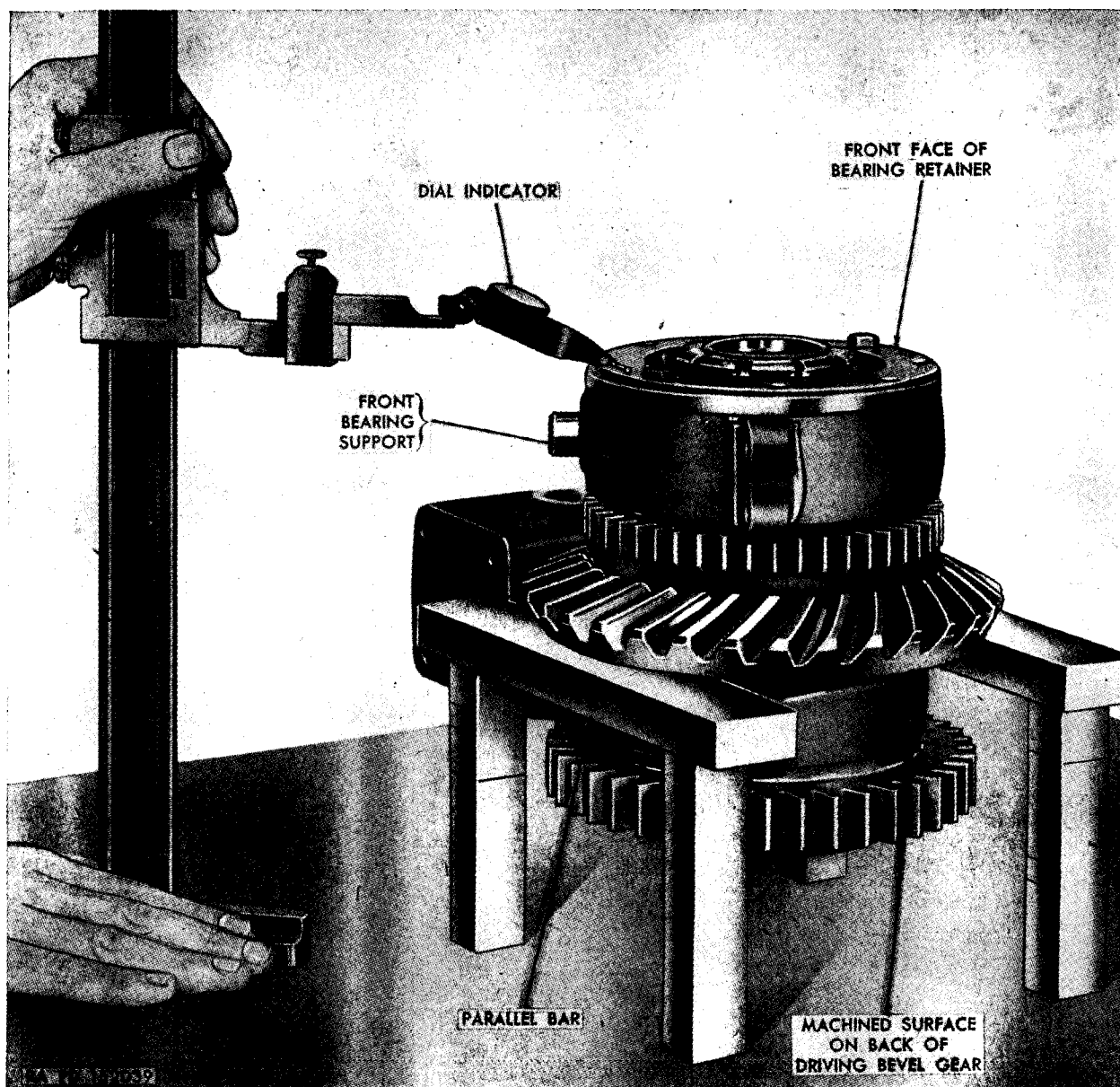


Figure 300. Measuring distance between bevel gear back and bearing retainer face.

- tract the last measurement from the first and the result will be the Z dimension.
- (7) Measure and record the distance from the machined surface on the back face of the bevel gear to the side of the left bearing nearest the lock nut. Subtract the step measurement (3) above, from the measurement just taken. The result will be the Y dimension.
 - (8) Subtract the Z dimension from the F dimension which is stamped in the left

housing. The result will be $(F-Z)$. Subtract the X dimension which is etched on the gear from the Y dimension. The result will be $(Y-X)$.

- (9) Subtract the result of $(Y-X)$ from the result of $(F-Z)$. This figure will be the nominal shim. The formula is $(F-Z) - (Y-X) = \text{Shim}$. Make up the shim pack and wire it to the converter-output shaft for safekeeping. Dispose of the old shim pack.

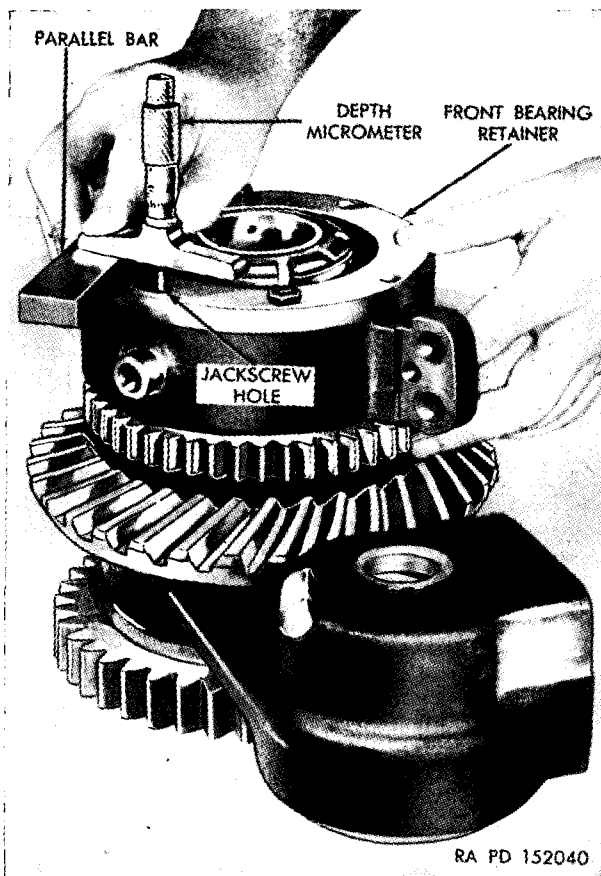


Figure 301. Measuring distance from bearing retainer face to bearing support.

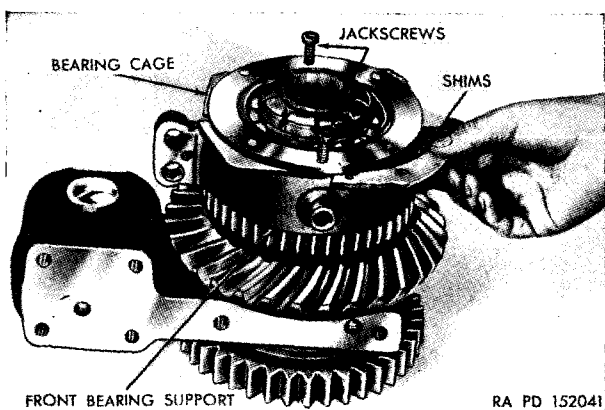


Figure 302. Installing shims.

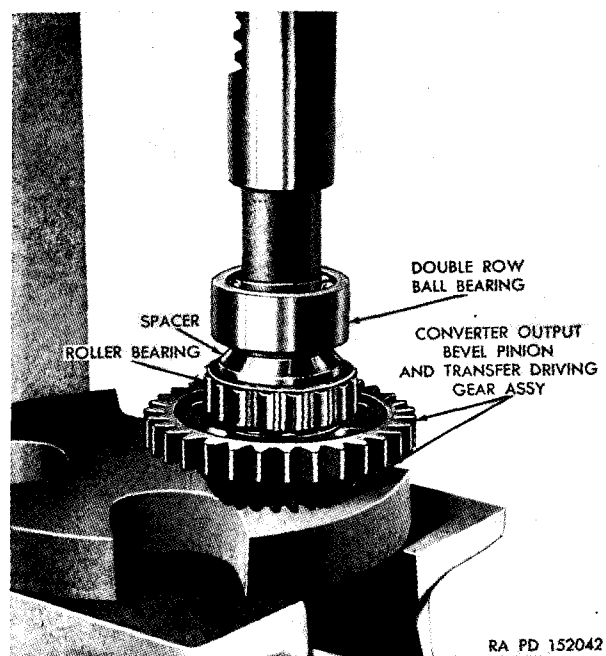


Figure 303. Installing bevel pinion bearing.

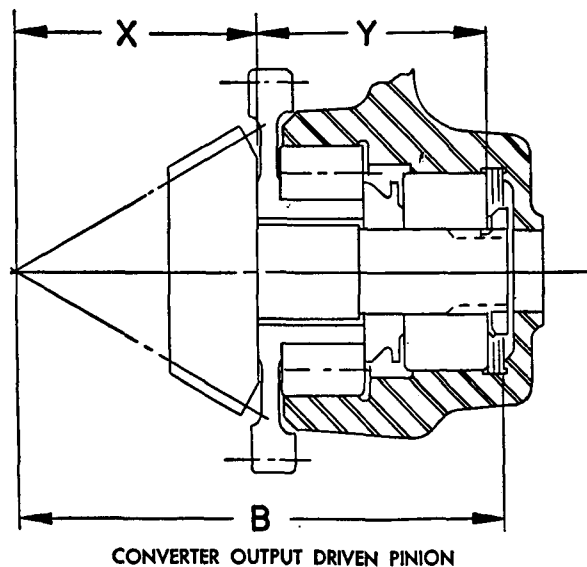


Figure 304. Converter output-driven-bevel pinion inspection chart.

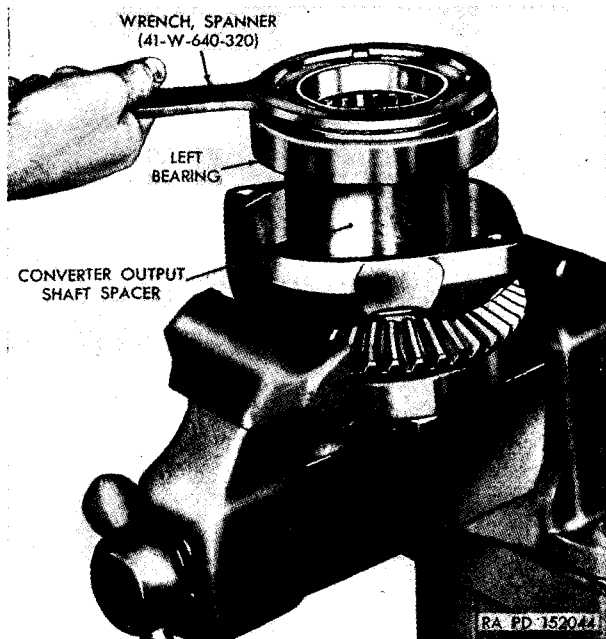


Figure 305. Removing converter-output-shaft lock nut.

h. INPUT-DRIVEN BEVEL GEAR AND BEARINGS (fig. 279).

- (1) Inspect the input-driven bevel gear and converter-drive gear. Inspect the double-row ball bearing, bearing cage and retainer. Replace any defective parts.

Note. If the input-driving bevel gear has been replaced it will be necessary to replace the input-driven bevel gear. These two bevel gears comprise a matched set and if one is replaced, both must be replaced with a new, matched gear set.

- (2) If either the input-driven bevel gear or its ball bearing cage has been replaced, a new nominal shim dimension must be calculated. Refer to figure 309 and *b* (7) through (9) above. Measure and record the distance from the outer face of the bearing-cage flange to the lip inside the cage. Measure and record the thickness of the bearing-cage flange. Subtract the last measurement from the first. The result is dimension *Z*.
- (3) Add dimension *Z* to the dimension $(X+Y)$ which is the larger of the two dimensions etched on the bevel gear. The sum is $(X+Y+Z)$.

Note. If only one dimension is given on the bevel gear it will be dimension *X*. In this case, determine dimension *Y* by measuring the dis-

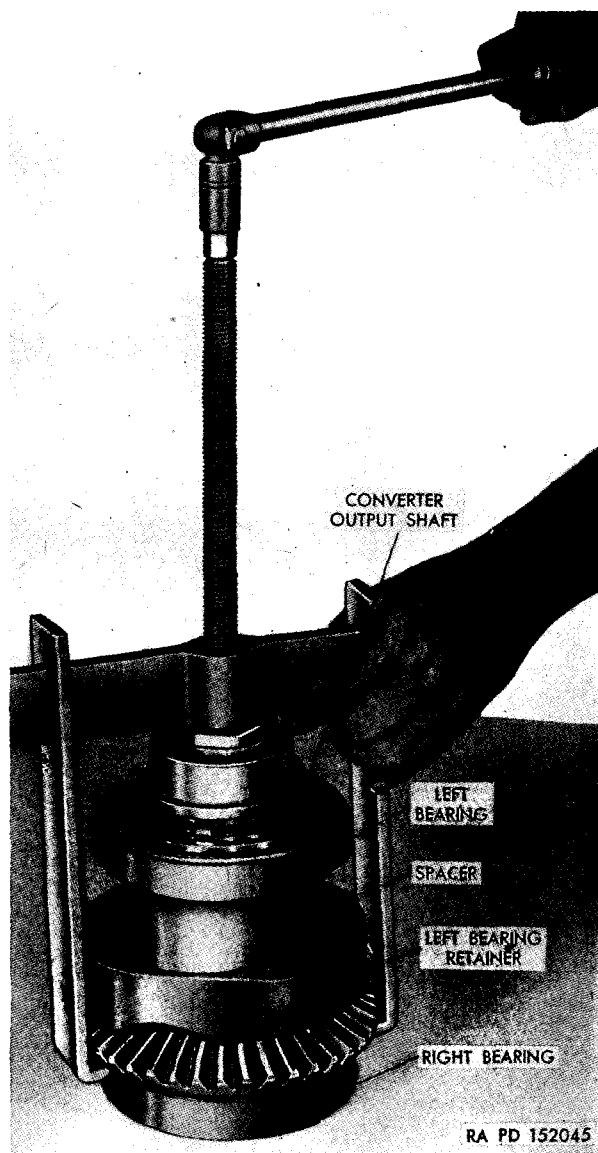


Figure 306. Removing converter driving bevel gear, spacer, retainer and left bearing.

tance from bearing side of the shoulder on the gear shaft to the machined surface on the back of the gear (fig. 310).

- (4) Subtract the dimension *K*, given in the right housing, from the sum $(X+Y+Z)$. The result is the nominal shim dimension $(X+Y+Z)-K=\text{Shim}$. Make up a new nominal shim pack and wire it to the bearing cage for safekeeping. Dispose of the old shim pack.

i. FAN- AND PUMP-DRIVE IDLER GEAR (fig. 311). Inspect the fan- and pump-drive idler gear and bearing assembly. If the gear or bearing is defec-

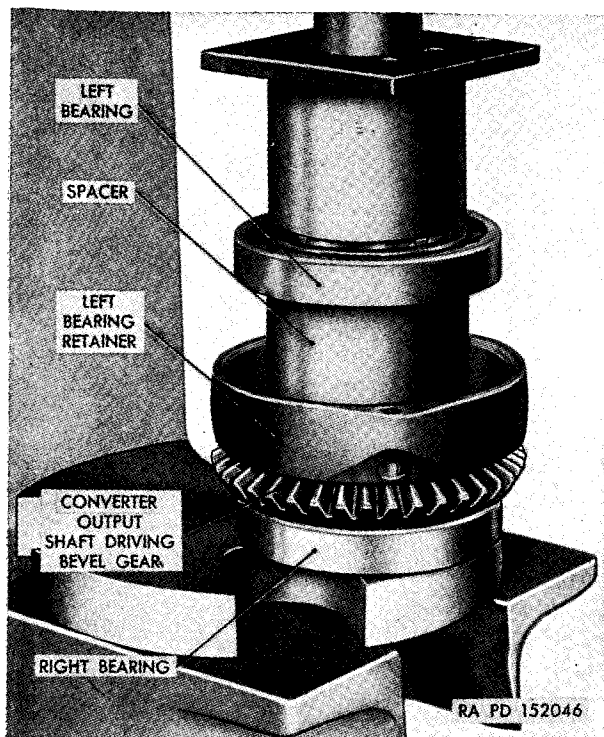


Figure 307. Installing converter-driving-bevel-gear left bearing.

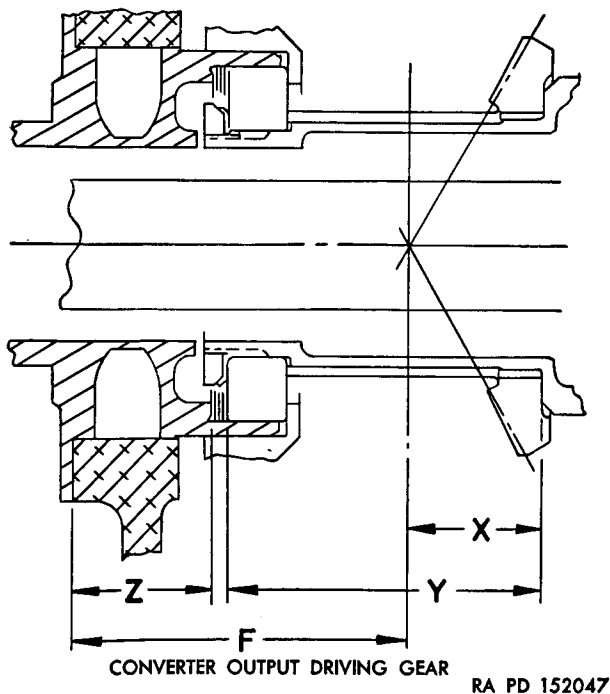
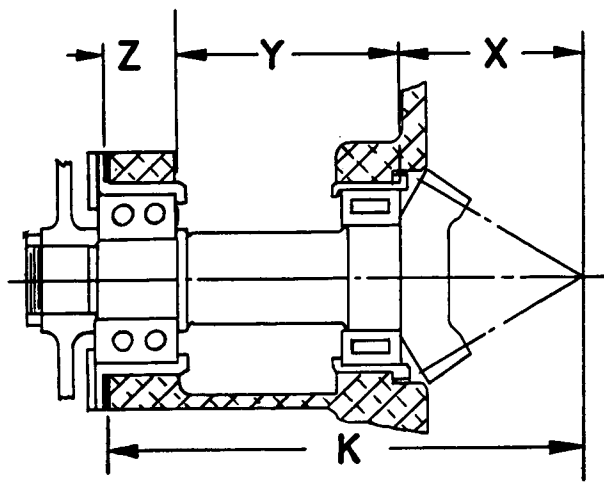


Figure 308. Converter-output-driving-bevel-gear inspection chart.



INPUT DRIVEN BEVEL PINION

RA PD 152048

Figure 309. Input-driven-bevel-gear inspection chart.

tive, turn back the gear metal which has been staked over the bearing. Press the bearing out of the gear using an arbor press. Inspect the idler-gear spindle. Replace all defective parts. Use an arbor press to install the bearing in the gear. Stake the gear metal over the bearing in four places spaced 90° apart.

j. CONVERTER-CIRCULATING-PUMP-BY-PASS VALVE (fig.312). Inspect the converter-oil-outlet

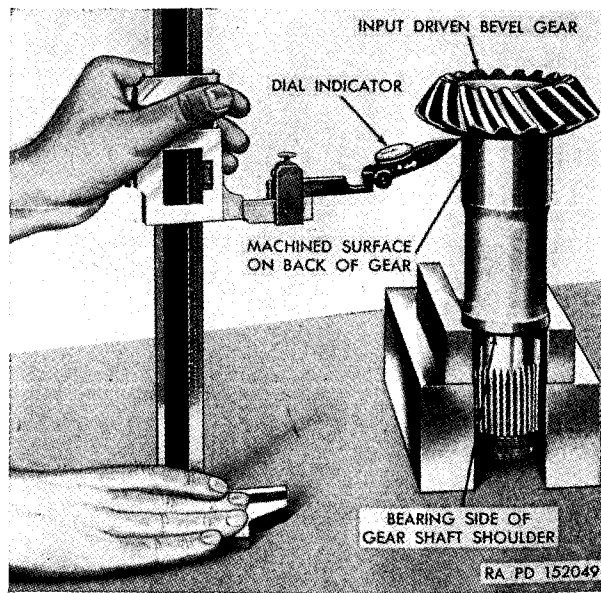


Figure 310. Measuring from shaft bearing shoulder to back of input-driven bevel gear.

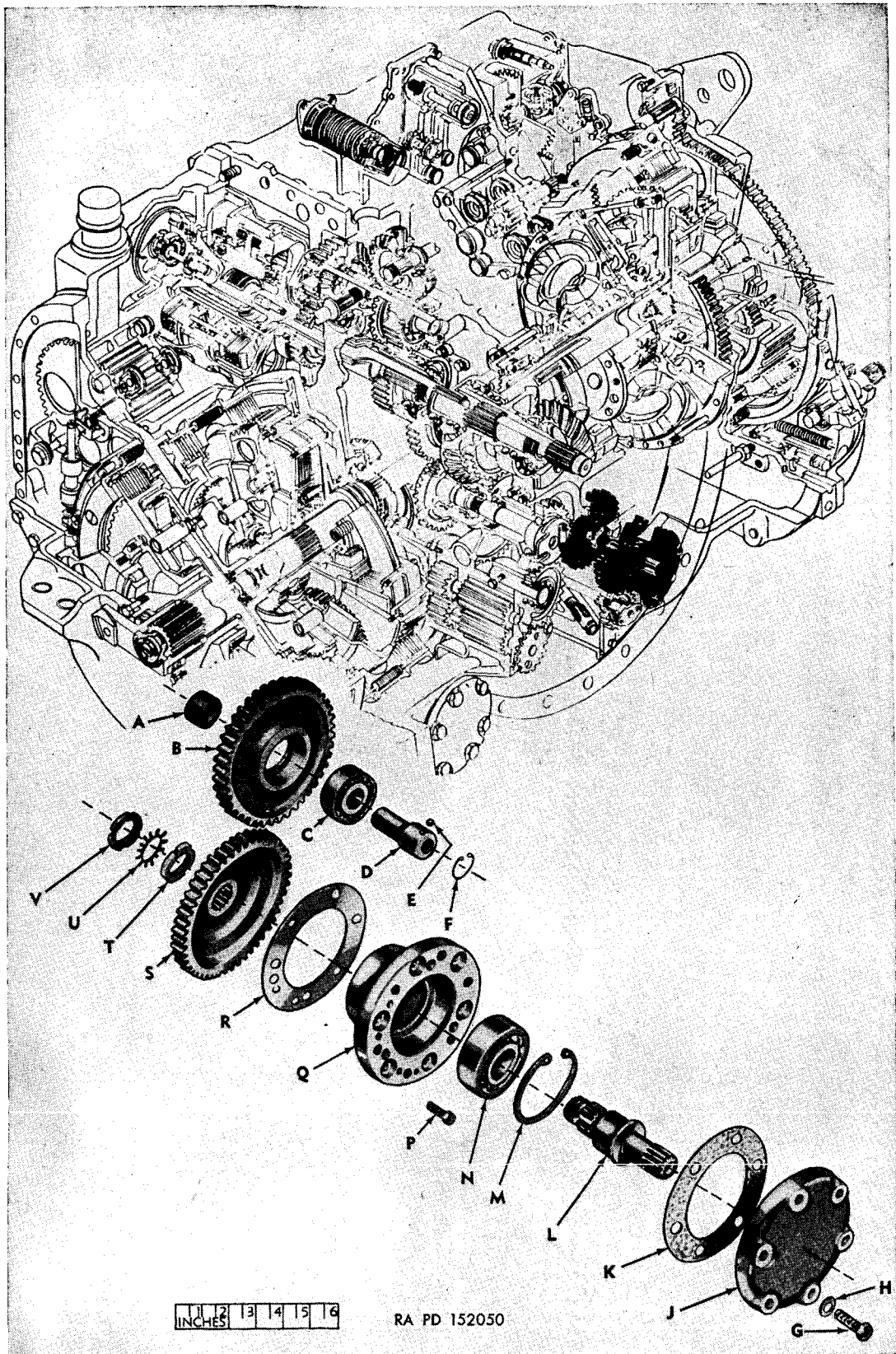


Figure 311. Fan drive and idler gear assemblies—exploded view.

A—SPACER GM-6765914
B—FAN- AND PUMP-DRIVE IDLER GEAR GM-6764797
C—BEARING GM-905304
D—IDLER GEAR SPINDLE GM-6765015
E—BALL GM-147483
F—SNAP RING GM-6703423
G—BOLT (6) GM-192094
H—WASHER (6) GM-103341
J—FAN DRIVE COVER GM-6763711
K—GASKET GM-6760388
L—FAN DRIVE COUPLING GM-6763726
M—SNAP RING GM-6704414
N—BEARING GM-954492
P—BOLT (6) GM-192278
Q—BEARING CAGE GM-6763722
R—GASKET GM-6760388
S—FAN- AND PUMP-DRIVE GEAR GM-6704419
T—NUT GM-6763603
U—TABBED LOCK WASHER GM-6763604
V—NUT GM-6763603

Figure 311—Continued.

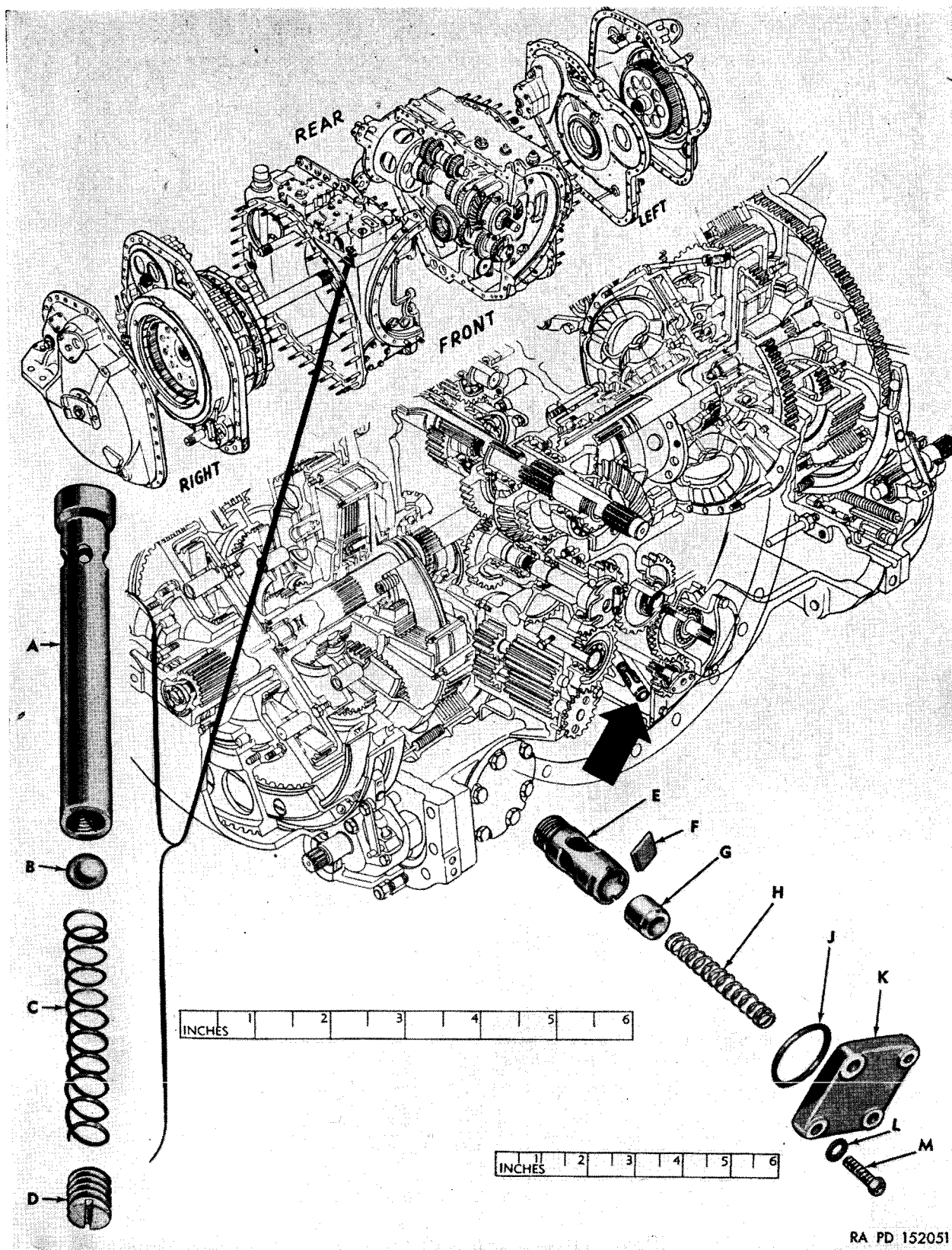


Figure 312. Converter-circulating-pump by-pass valve and main pressure-relief-valve body assemblies—exploded view.

A—MAIN PRESSURE RELIEF VALVE BODY GM-6760375
B—BALL GM-147497
C—SPRING GM-8894438
D—PLUG GM-6760373
E—SLEEVE GM-6765428
F—SPRING RETAINER GM-6765691
G—CONVERTER CIRCULATING PUMP BY-PASS VALVE GM-6765692
H—SPRING GM-6765693
J—“O” RING GASKET GM-6761318
K—CONVERTER OIL OUTLET COVER GM-6760106
L—WASHER (4) GM-103341
M—BOLT (4) GM-192094

Figure 312—Continued.

cover and "O" ring gasket. Inspect the by-pass valve assembly for sticky operation, weak or broken spring, and improper seating of valve. If any of these defects are found, remove the spring retainer, spring, and valve from the sleeve. Replace any defective parts. To assemble, install the valve and spring in the sleeve. Depress the spring and install the spring retainer. Check the valve for free action.

k. FAN-DRIVE COUPLING ASSEMBLY AND GEAR (fig. 311).

- (1) Inspect the fan-drive cover and gasket. Inspect the fan-drive coupling assembly and gasket. Inspect the fan-drive gear. If the coupling assembly is defective, remove the bearing-retaining snap ring from the bearing cage, using snap ring pliers (41-P-1992-36) (fig. 313).
- (2) Remove the coupling from the cage and press the coupling out of the bearing. Replace all defective parts. To assemble, install the bearing on the coupling and seat the bearing using an arbor press. Press the coupling and bearing assembly into the bearing cage. Install the retaining snap ring (fig. 313).

l. INPUT-PRESSURE-PUMP DRIVE GEAR (fig. 363).

- (1) Inspect the input-pressure-pump drive gear and bearing assembly. If the bearing must be removed from the gear, use a small chisel to turn back the gear metal which has been peened over the bearing. Drive the bearing out of the gear using a drift.
- (2) To assemble, press the bearing into the gear using an arbor press. Use a small punch to peen the gear metal over the bearing in four places at 90° intervals. Inspect the drive-gear-internal snap ring and remove it from the gear if it is defective. Inspect the drive shaft and the coupling. Remove the snap ring from the coupling if it is defective. Replace any defective parts.

m. LEFT HOUSING (fig. 314).

- (1) Inspect the input-scavenge-pump-outlet tube assembly and the converter-circulating-pump-outlet tube assembly. Inspect the brake-pump-pickup tube. Inspect the housing and oil tubes. Inspect the steering-clutch-oil baffle for looseness

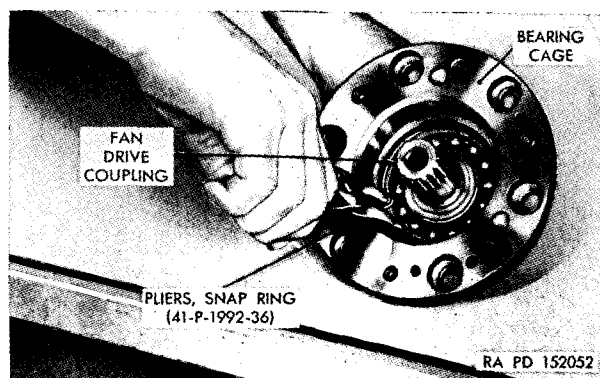


Figure 313. Removing or installing bearing-retaining snap ring.

and dents. Replace it if it is defective. If the steering-differential inspection plate has been leaking, remove it and replace the "O" ring gasket.

- (2) Do not remove the transmission vent cap unless the cap or gasket is defective. Inspect all "O" ring gaskets. Inspect the input-driven-bevel-gear roller bearing for defects. If defective, remove the snap ring, using a screwdriver (fig. 315). Drive out the bearing, using a soft drift (fig. 316).
- (3) If the left housing is defective, replace the left housing, right housing, right steering-shaft-bearing support, input-shaft-front-bearing support, and the converter-output-driven-bevel-gear support as an assembly.

Note. If the housings are replaced, new nominal shim packs must be calculated for all the bevel gears, see b (7) through (9) above.

59. Assembly of Left Housing

a. STEERING-DIFFERENTIAL INSPECTION PLATE.

- (1) If the steering-differential inspection plate has been removed from the left housing, install it on the housing (fig. 317), making sure the "O" ring gasket is seating properly. Install two $\frac{5}{16}$ -inch washers and nuts to secure the plate. Torque the nuts 25 to 30 pound-feet and install two jam nuts. Install the input-pressure-pump-drive-gear spindle and gasket (fig. 318).
- (2) Install the spindle lock plate and two $\frac{5}{16}$ -inch nuts to secure the spindle. Bend over the corners of the lock plate to

secure the nuts. Install the input-pressure-pump drive gear on the spindle (fig. 319) and tap in place with a soft hammer. Using snap ring pliers and a screwdriver, install the gear-retaining snap ring on the spindle (fig. 255).

b. CONVERTER GROUND SLEEVE.

- (1) Install the fan-drive-bearing-cage gasket on the fan-drive-bearing cage. Install the fan-drive-bearing cage and coupling assembly in the left housing, being careful to align the oil-drain holes in the gasket and the cage with the oil-drain hole in the housing (fig. 254). Secure the fan-drive-bearing cage to the housing with six $\frac{3}{8}$ -inch bolts. Torque the bolts 26 to 32 pound-feet.
- (2) Install the fan-drive cover and gasket and secure with six $\frac{3}{8}$ -inch bolts and washers. Check to see that one "O" ring gasket is installed against the flange on the converter ground sleeve and that another is properly installed in the housing-ground-sleeve bore. Position the ground sleeve at the housing bore so that the dowel pin in the ground sleeve is toward the top of the transmission housing (fig. 320).
- (3) Install a $\frac{3}{8}$ -inch fine thread guide bolt, about 4 inches long, in a bolt hole on each side of the converter ground sleeve. With the bolts as a guide, and using a soft hammer, seat the ground sleeve in the housing bore (fig. 321). Be careful to see that the "O" ring gasket in the housing bore is seated properly as the sleeve goes into the bore.
- (4) If possible, chill the ground sleeve before installation. Secure the ground sleeve with six $\frac{3}{8}$ -inch bolts and torque 33 to 40 pound-feet.

Note. Do not install locking wire through the bolts at this time.

c. FAN-DRIVE IDLER GEAR.

- (1) Install the fan- and pump-drive gear on the fan-drive coupling (fig. 252). Install and tighten one lock nut using spanner wrench (41-W-640-285) (fig. 251). Install the tabbed lock washer and bend a tab into the lock nut. Install the other lock nut and tighten it. Bend a tab of the lock washer into the lock nut.

- (2) Install the fan-drive idler gear and spindle (fig. 322).

Note. Make sure the locating ball is properly positioned on the spindle when the spindle is inserted into the housing bore.

Using snap ring pliers (41-P-1992-27), install the spindle-retaining snap ring in the housing.

d. INPUT PRESSURE PUMP.

- (1) Install the input-pressure-pump drive shaft in the drive gear (fig. 323). Install the two "O" ring gaskets on the housing to input pressure pump jumper tube. Install the jumper tube, snap ring groove side up, in the housing. Push the tube up into the housing as far as it will go (fig. 324). Install the large "O" ring gasket against the pump cover flange. Install the "O" ring gaskets on the pump base (fig. 325).
- (2) Make sure that the coupling is in place in the pump base. Install the pump in the housing (fig. 325) being careful to see that the externally splined drive shaft enters the internally splined coupling. Secure the pump to the housing with four $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet.
- (3) Using a screwdriver, push the jumper tube down so that its lower end enters the input-pressure-pump elbow. Install the E-type snap ring to position the jumper tube.

e. OUTLET TUBES. Install the input-sump-pump-outlet tube (fig. 250). Secure the tube with four $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet. Install the converter-circulating pump-outlet tube, making sure that the two "O" ring gaskets are in place on the housing (fig. 249). Secure the tube with four $\frac{5}{16}$ -inch bolts and torque the bolts 17 to 20 pound-feet.

f. INPUT-DRIVEN BEVEL GEAR.

- (1) Install the input-driven-bevel-gear ball bearing and cage assembly in the housing. Install the proper shim pack (fig. 326) between the cage and the housing. Using a soft hammer, seat the bearing assembly against the housing, taking care to see that the bolt holes in the housing, shims, and cage are aligned.

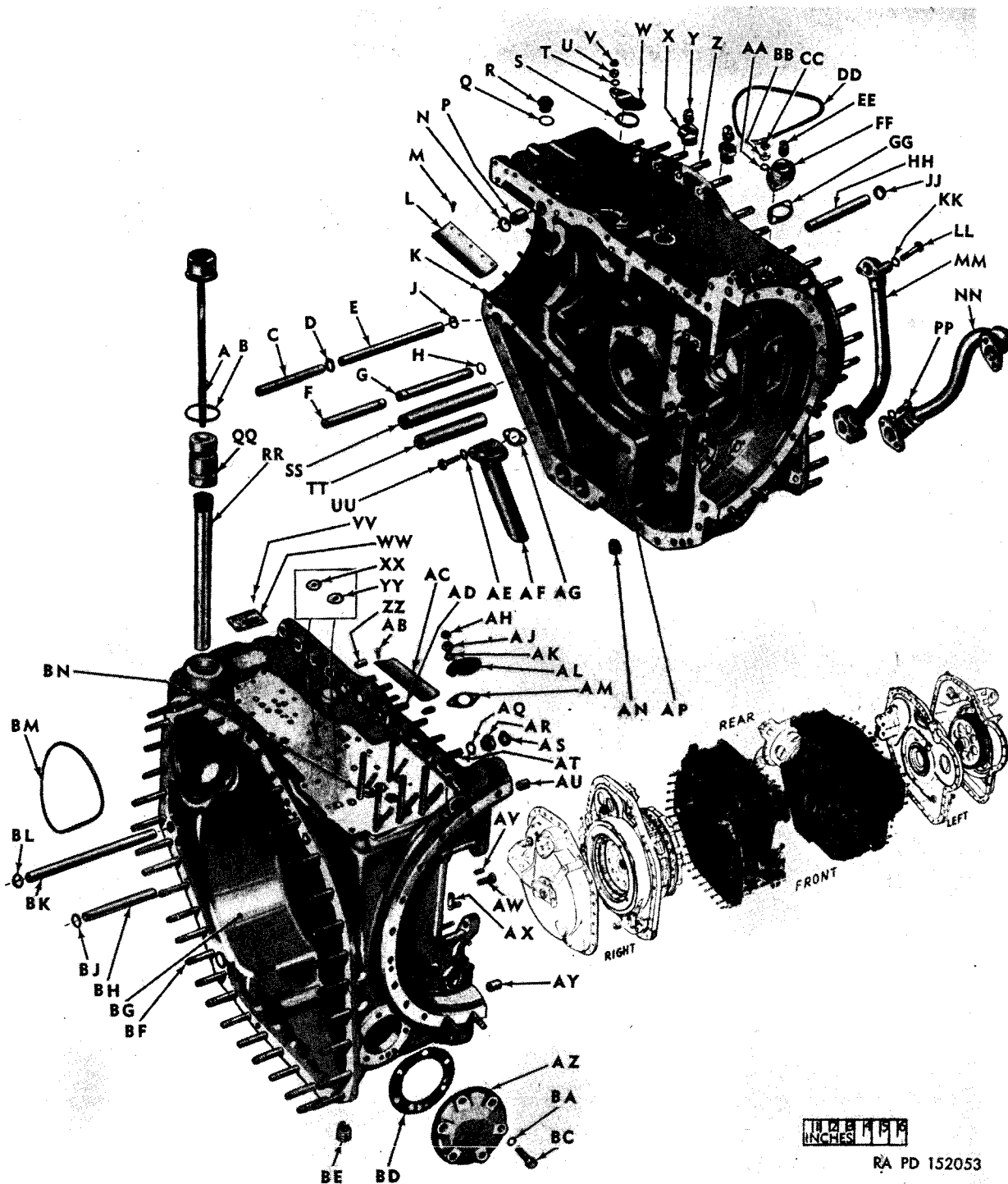


Figure 314. Left and right housing assemblies—exploded view.

A—OIL LEVEL INDICATOR ASSEMBLY GM-6765066	TT—CONVERTER "OUT" OIL TUBE GM-6760256
B—SEAL GM-6765069	UU—BOLT (2) GM-221592
C—BRAKE LUBE TUBE GM-6764545	VV—DRIVE SCREW (4) GM-142862
D—"O" RING GASKET GM-6760478	WW—NAME PLATE GM-6704000
E—BRAKE LUBE TUBE GM-6764544	XX—SAFETY VALVE ORIFICE GM-6765423
F—LUBE OIL TUBE GM-6760255	YY—LOW RANGE CLUTCH ORIFICE GM-6765434
G—LUBE OIL TUBE GM-6760257	ZZ—DOWEL (2) GM-141283
H—"O" RING GASKET GM-6760252	AB—SCREW (5) GM-110531
J—"O" RING GASKET GM-6760478	AC—STEERING CLUTCH OIL BAFFLE GM-6765417
K—STUD (18) GM-6760362	AD—BOLT (12) GM-181441; (1) GM-181434
L—STEERING CLUTCH OIL BAFFLE GM-6765417	AE—WASHER (2) GM-103340
M—SCREW (5) GM-110531	AF—BRAKE PUMP PICK-UP TUBE GM-6764063
N—"O" RING GASKET GM-6762127	AG—GASKET GM-6764065
P—MAIN PRESSURE JUMPER TUBE GM-6763977	AH—JAM NUT (2) GM-147510
Q—GASKET GM-8894371	AJ—NUT (2) GM-103025
R—STEER PLATE INSPECTION PLUG GM-6764151	AK—WASHER (2) GM-103340
S—"O" RING GASKET GM-6760265	AL—TIMING HOLE COVER GM-6764778
T—WASHER (2) GM-103340	AM—GASKET GM-6764777
U—NUT (2) GM-103025	AN—MAGNETIC DRAIN PLUG GM-6763249
V—JAM NUT (2) GM-147510	AP—LEFT HOUSING GM-6763955
W—STEERING DIFFERENTIAL INSPECTION PLATE GM-6760266	AQ—WASHER (45) GM-103343
X—REDUCER GM-144061	AR—NUT (32) GM-103028
Y—PIPE PLUG GM-6765215	AS—JAM NUT (32) GM-145493
Z—STUD (35) GM-6760361; (3) GM-6760722	AT—STUD (17) GM-6760151; (2) GM-6760870
AA—WASHER (2) GM-103341	AU—DOWEL GM-187464
BB—NUT (2) GM-103026	AV—DOWEL (2) GM-141244
CC—JAM NUT (2) GM-107322	AW—BOLT GM-192099
DD—SEAL RING GM-6760452	AX—INPUT BEVEL GEAR NOZZLE ASSEMBLY GM- 6764512
EE—PIPE PLUG GM-6765216	AY—DOWEL GM-6760310
FF—VENT CAP GM-6765239	AZ—FAN DRIVE COVER GM-6763711
GG—GASKET GM-6700941	BA—WASHER (6) GM-103341
HH—CONVERTER SIGNAL TUBE GM-6763978	BC—BOLT (6) GM-192094
JJ—"O" RING GASKET GM-6763013	BD—GASKET GM-6760388
KK—WASHER (8) GM-103340	BE—MAGNETIC DRAIN PLUG GM-6763249
LJ—BOLT (4) GM-221588	BF—STUD (33) GM-6760361; (3) GM-6760722
MM—INPUT SCAVENGE PUMP OUTLET TUBE ASSEMBLY GM-6760168	BG—RIGHT HOUSING GM-6763960
NN—CONVERTER CIRCULATING PUMP OUTLET TUBE ASSEMBLY GM-6764153	BH—LUBE OIL TUBE GM-6760254
PP—BOLT (4) GM-221584	BJ—"O" RING GASKET GM-6760252
QQ—OIL FILLER TUBE ASSEMBLY GM-6765063	BK—BRAKE LUBE TUBE GM-6764546
RR—OIL FILLER SCREEN ASSEMBLY GM-6765071	BL—"O" RING GASKET GM-6760478
SS—CONVERTER "IN" OIL TUBE GM-6760259	BM—SEAL RING GM-6703118
	BN—STUD (5) GM-6760380

Figure 314—Continued.

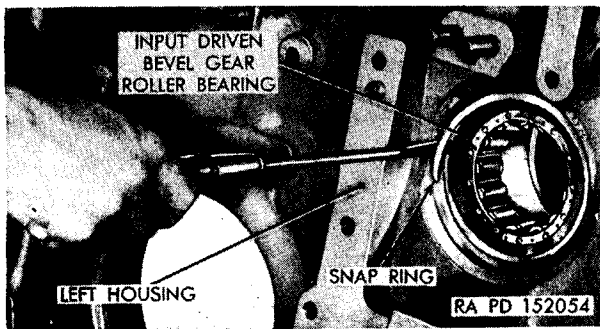


Figure 315. Removing bearing-retaining snap ring.

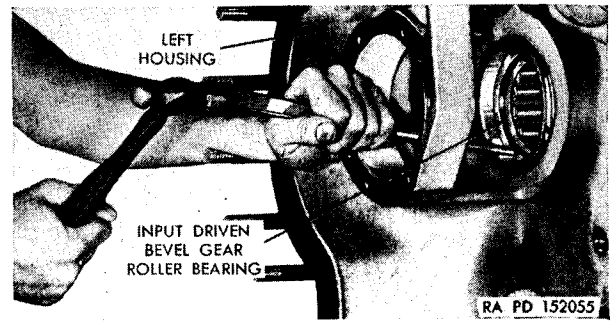


Figure 316. Removing input-driven-bevel-gear roller bearing.

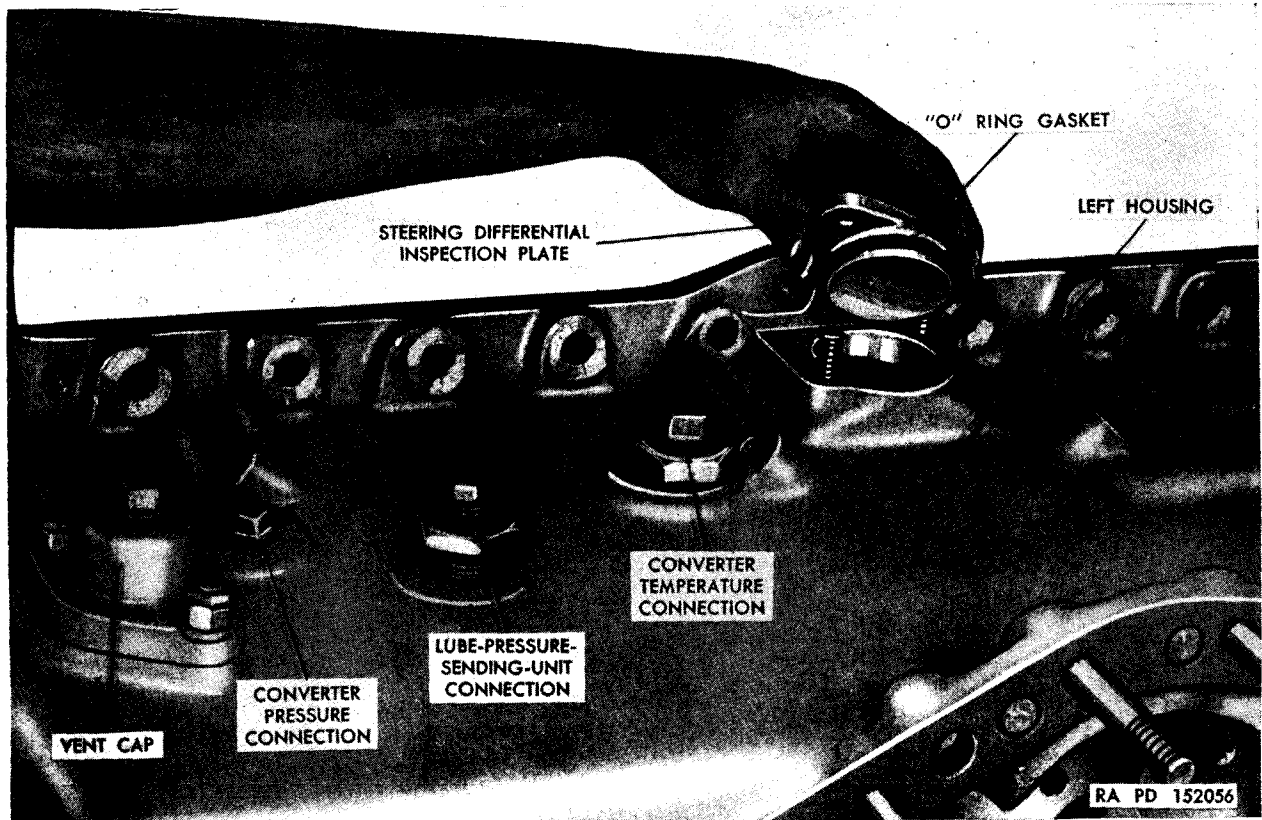


Figure 317. Installing steering-differential inspection plate.

- (2) Install the bearing retainer (fig. 247). Secure the bearing retainer and the bearing cage assembly with six $\frac{3}{8}$ -inch bolts torqued 33 to 40 pound-feet. Install the input-driven bevel gear through the roller bearing and into the ball bearing using a bearing press (fig. 327). Block the transmission on its side with the studs down.

g. INPUT SCAVENGE AND CONVERTER CIRCULATING PUMP.

- (1) Install and tighten the converter-circu-

lating-pump-by-pass valve assembly in the housing (fig. 244). Install the converter-oil-outlet cover over the valve (fig. 243), making sure the "O" ring gasket is installed in the cover. Secure the cover with four $\frac{3}{8}$ -inch bolts and washers. Torque the bolts 33 to 40 pound-feet.

- (2) Check to see that the three "O" ring gaskets are installed on the left to right housing split line. Make sure that one "O" ring gasket is installed on each of

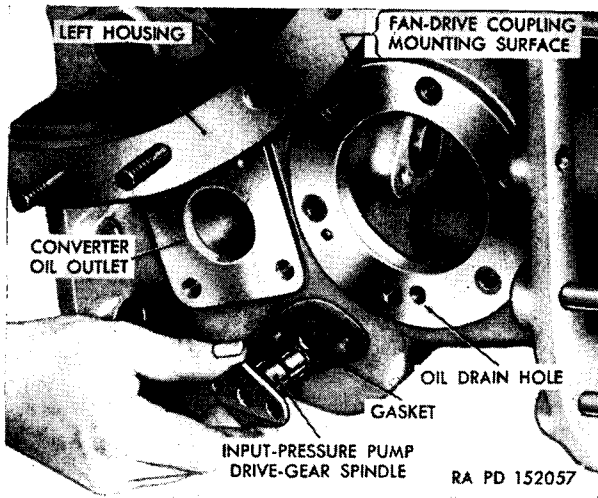


Figure 318. Installing input-pressure-pump-drive-gear spindle.



Figure 319. Installing input-pressure-pump drive gear.

the two oil tubes which are located in the housing on the input-scavenge- and converter - circulating - pump mounting surface.

- (3) See that the jumper tube with two "O" ring gaskets is installed in the input-scavenge- and converter-circulating pump. Install the pump (fig. 241), and secure it with three $\frac{5}{16}$ -inch castellated nuts and washers. Torque the nuts 17 to 20 pound-feet and install cotter pins.

h. CONVERTER OUTPUT SHAFT.

- (1) Install the converter-output-shaft shim

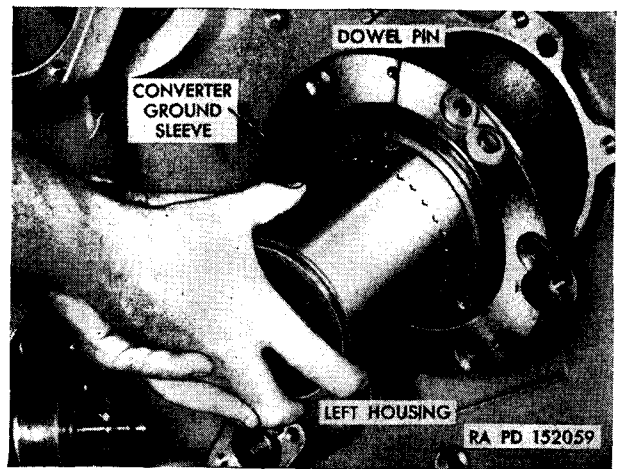


Figure 320. Installing converter ground sleeve.

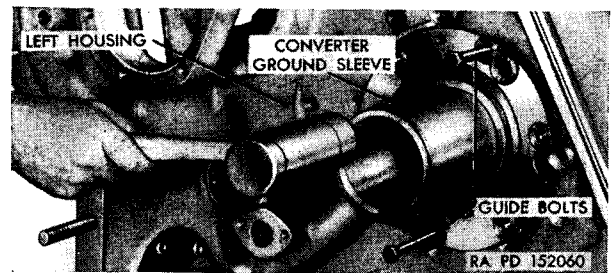


Figure 321. Seating ground sleeve.

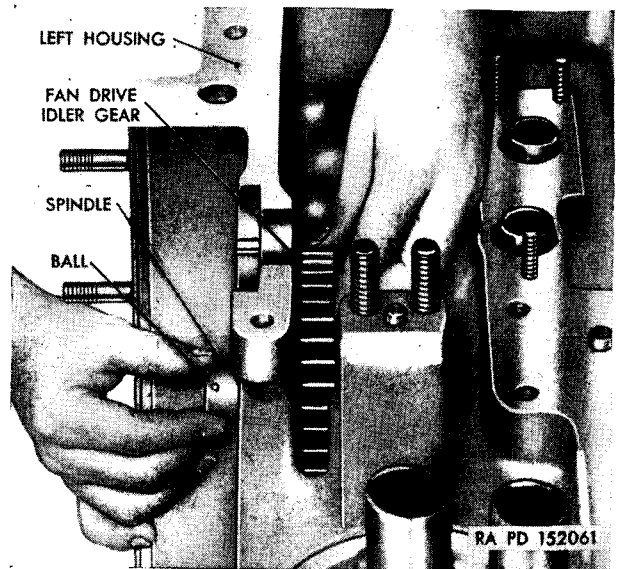


Figure 322. Installing fan-drive idler gear and spindle.

pack in the converter ground sleeve. Position the shaft on top of the ground sleeve (fig. 240). Set the input gearing assembly on the locating dowels in the housing (fig. 239).

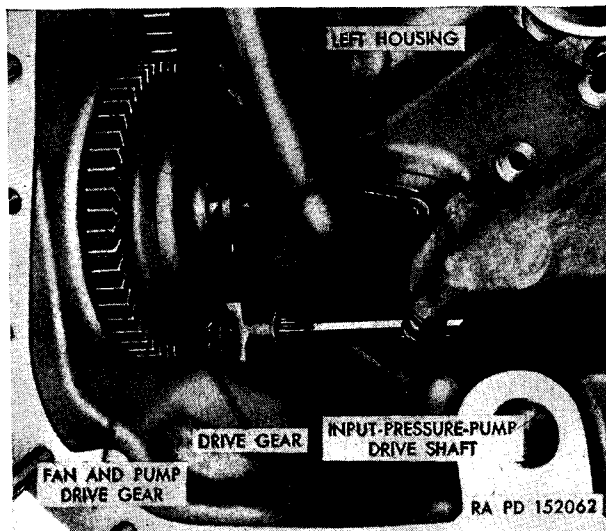


Figure 323. Installing input-pressure-pump drive shaft.

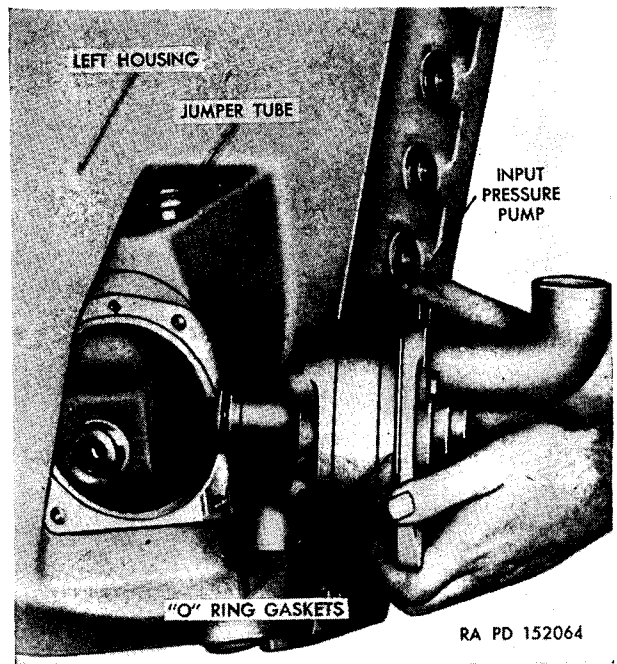


Figure 325. Seal rings installed on input pressure pump.



Figure 324. Installing input-pressure-pump jumper tube.

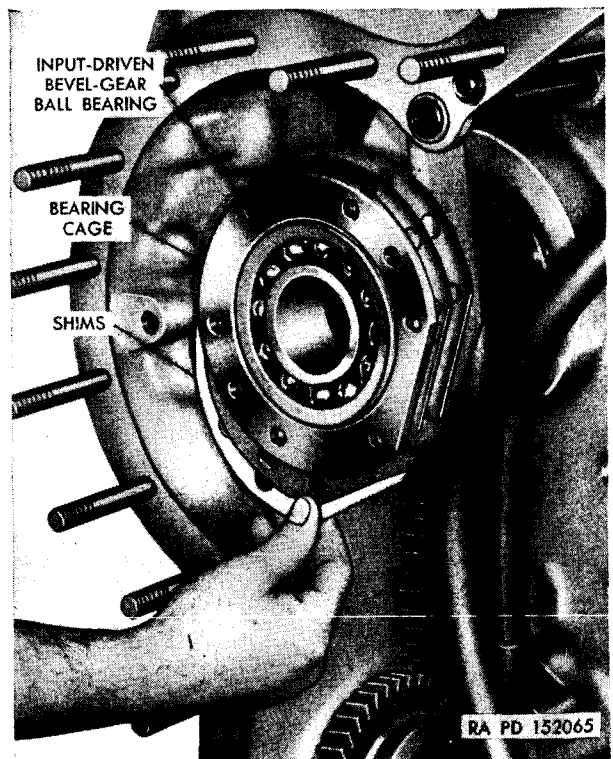
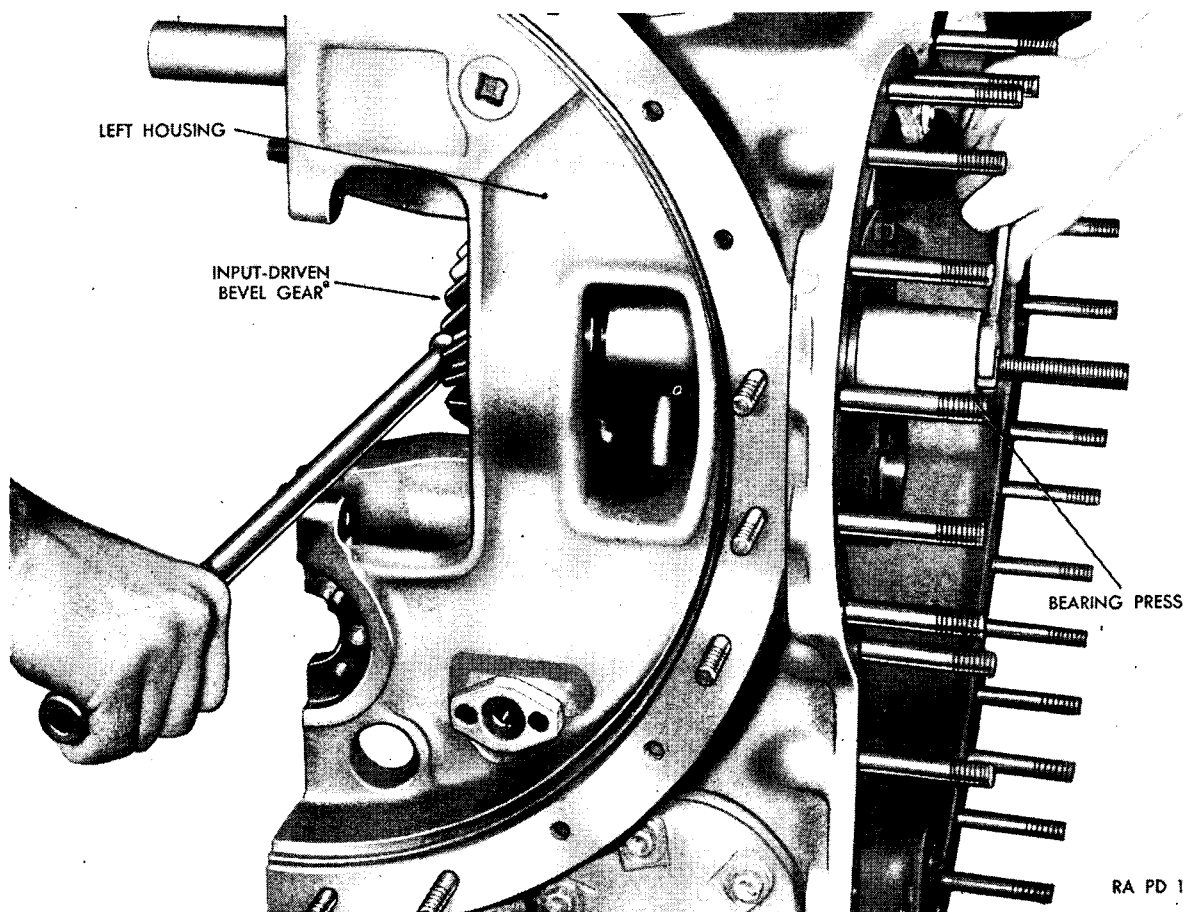


Figure 326. Installing shims.



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Figure 327. Installing input-driven bevel gear.

- (2) Using a soft hammer, tap lightly on the converter-output shaft and on the input-gearing supports so as to seat both assemblies at the same time. Install four $\frac{1}{2}$ -inch castellated nuts and torque them 42 to 50 pound-feet. Install cotter pins to secure the nuts.

i. **FAN AND PUMP PINION.** Install the fan and pump drive pinion in the housing (fig. 236). Install the fan and pump drive pinion shaft through the pinion, using a soft hammer to seat it in the housing. Install one of the lock plates and two nuts on the studs which retain the shaft.

Note. Do not tighten the nuts.

j. **LEFT STEERING CROSS SHAFT.** With the shim pack in place behind the bearing cage, install the left steering cross shaft bearing cage in the left housing. Install the left steering cross shaft assembly in the cage (fig. 233). Secure the assembly with four $\frac{5}{16}$ -inch castellated nuts torqued

9 to 11 pound-feet. Install cotter pins in the four nuts.

k. TORQUING INPUT-SHAFT LOCK NUT.

- (1) Install the input-bevel-gear locking tool on the front end of the housing. Install the spanner wrench on the input-shaft lock nut (fig. 237). Refer to paragraph 56d(1). Using a torque wrench, torque the nut to 350 pound-feet minimum (fig. 328).

Note. The input-shaft lock nut has a left-hand thread.

Remove the gear locking tool and the spanner wrench.

- (2) Install the lock ring on the input-shaft lock nut. Stake metal over the lock ring in three places. Install the right and left steering shaft assembly, making sure that the bearing support on the front end of the shaft and the bearing cage on

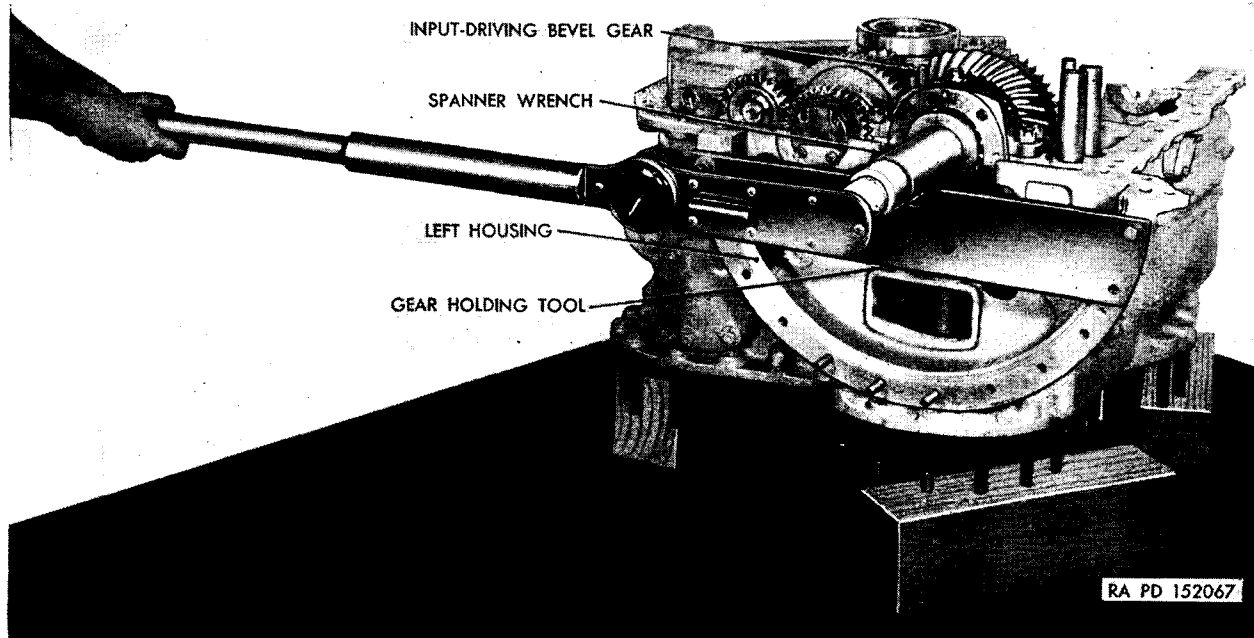


Figure 328. Installing input-shaft lock nut.

the rear end are properly seated on their dowels (fig. 232). Install the steering differential assembly, making sure that the assembly is properly seated on the dowels in the housing (fig. 231).

- (3) Install the pressure-control valve assembly and gasket on the housing.

Note. Be sure the two jumper tubes are installed in valve assembly and that the four "O" ring gaskets are not defective.

Secure the assembly with nine $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet.

- (4) Install the main-oil filter in the housing, make sure that the "O" ring gasket is not defective. Secure the filter with three $\frac{3}{8}$ -inch bolts and washers. Torque the bolts 33 to 40 pound-feet. Install 12 bolts and washers in the converter and oil reservoir wells to secure the input gearing and the steering shafts assembly.

NOTE. At this time tighten these bolts to "snug." They will be torqued later.

1. BEVEL GEAR BACKLASH AND MESH PATTERN ADJUSTMENT.

- (1) If the nominal shim pack for a bevel gear has been lost, or if it has been changed because of replacement of parts

during the rebuild of the right or left housing, an inspection must be made of the backlash and the mesh pattern between that gear and the gear or gears with which it meshes. After the bevel gears have been correctly installed in the housings, all the gear sets except two can be inspected for backlash and mesh pattern with the right and left housings separated. The exceptions are the converter-output bevel gear set and the right steering-cross-shaft gear.

- (2) Bevel gears are made to operate with a specific amount of backlash. When bevel gears are installed in the housing, they must be adjusted and checked for the proper amount of backlash.

Note. If there is insufficient backlash, the gears will be noisy, wear excessively, scuff and possibly break.

The amount of backlash required in a gear set is etched on the gears.

- (3) To measure the backlash in a gear set, hold either the gear or the pinion rigidly so that it cannot rotate. Mount a dial indicator so that the indicator stem is near the heel of a tooth on the free gear (the one which is not being held). Make sure that the indicator stem is perpendic-

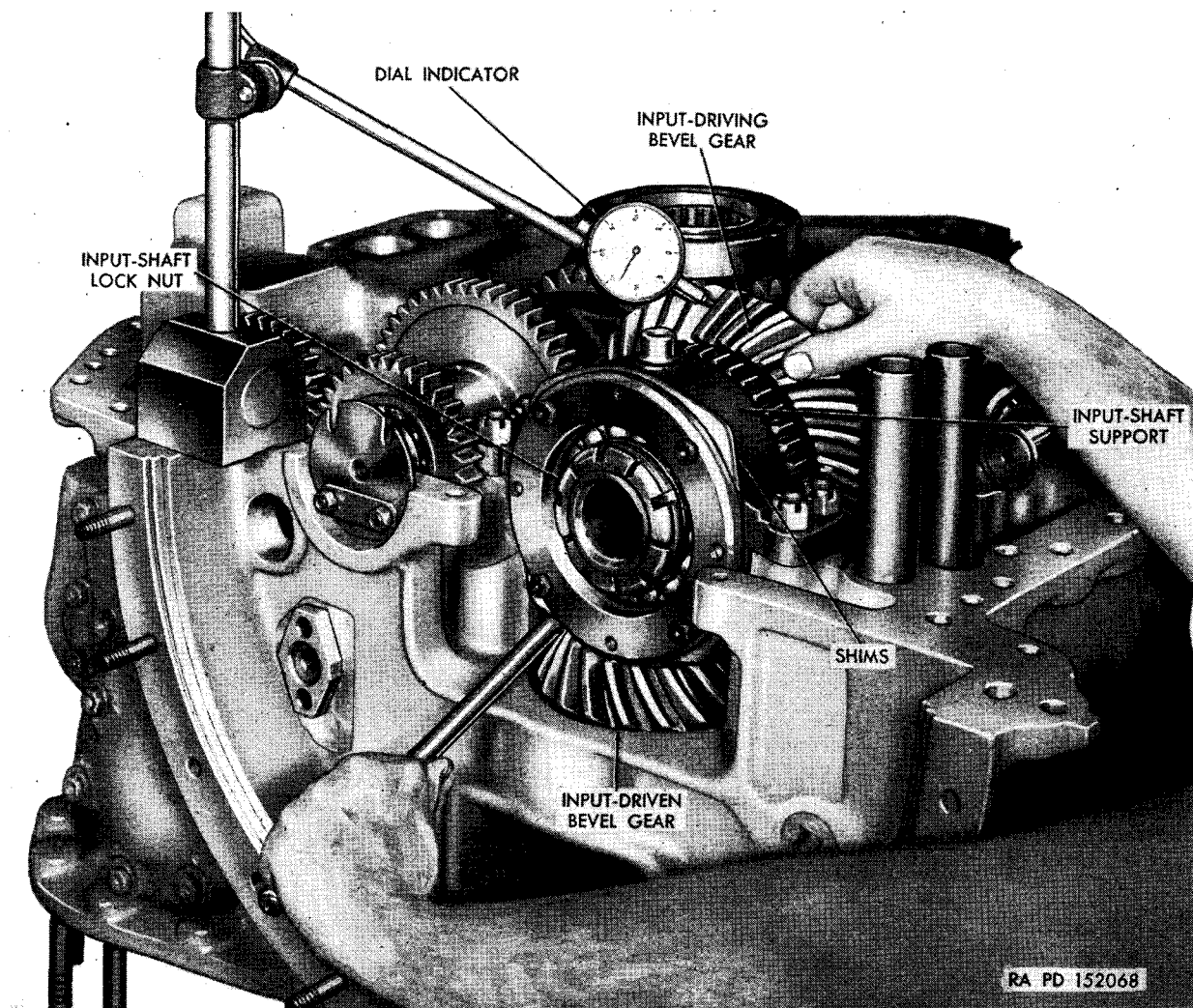


Figure 329. Input-driving-bevel-gear backlash check.

ular to the tooth surface (fig. 329). The backlash will be shown by the indicator when the free gear is moved back and forth. Release the held gear and rotate the gear set several times. Check the backlash again at a different point on the free gear. Repeat this procedure several times. Take the lowest backlash obtained as the minimum backlash of the gear set, for the adjustment procedures.

- (4) To check the mesh pattern in a gear set, paint the teeth of one gear with a mixture of red lead and machine oil. The red lead mixture should be stiff so that it will not run when applied to the gear teeth. Rotate the driving gear several revolutions in the direction of normal

rotation, while retarding the rotation of the driven gear as much as possible by hand loading. Inspect the mesh pattern on the gear that was painted.

- (5) The gear set adjustment is correct only when the proper mesh pattern and the required amount of backlash are obtained. The ideal mesh pattern or tooth bearing pattern on the driving gear of each bevel gear set is shown in figure 330. The length of the tooth pattern under light load should be about one-half of the tooth length.
- (6) The tooth bearing pattern will usually shift toward the heel or outer end of the tooth when the gears are operating under heavy load. To counteract the

pattern shift under heavy load, the gears are to be adjusted so that the pattern will be nearer to the toe or inner end of the tooth than to the heel. The tooth pattern chart (fig. 330) indicates the adjustments to be made if the proper pattern is not obtained with the nominal shims.

- (7) In most cases when attempting to obtain the correct backlash and pattern, it will be found that moving the smaller gear toward the cone center (J of fig. 330) will give more toe pattern. Moving the smaller gear away from the cone center (L of fig. 330) will give less toe pattern. Moving the larger gear toward the cone center (H of fig. 330) will reduce the amount of backlash; moving it away (K of fig. 330) will increase the backlash.
- (8) Before checking the backlash and pattern on the input bevel gear set, be sure that the input shaft and driving bevel gear supports are fastened securely to the housing. The lock nut on the input shaft must be torqued to 300 pound-feet. The converter drive gear and the lock nut must be installed on the driven bevel gear and the lock nut torqued to 350 pound-feet.
- (9) Check the backlash (fig. 329) and pattern ((3) and (4) above) on the input driving bevel gear. The ideal pattern is a central toe pattern that is centered slightly above the pitch line on the tooth surface (B of fig. 330). More of the pattern area should be on the addendum or face of the gear tooth. If the proper pattern is not obtained with nominal shims, refer to figure 330, items D, E, F, and G and to the instructions. Move each gear, if necessary, according to the instructions by installing or removing shims. Again check the backlash and mesh pattern. Repeat this procedure until a central toe pattern is obtained with a *minimum* backlash between 0.006 and 0.012 inch ((3) above). In this case disregard the backlash etched on the gear.
- (10) Before checking the backlash and pattern on the converter-output bevel gear set, be sure that bolts holding the converter-output-bevel-gear-shaft bearing

are securely fastened to the housing. Be sure that the converter-output-driven-gear lock nut is tight and that the driven gear assembly is seated against the shims in the support and locked in place with the lock screw. Coat the teeth of the converter-output driving gear for a mesh pattern check ((4) above).

- (11) Install the preloading tool in the ground sleeve so that it rests against the internal splines of the converter-output-driving-bevel-gear shaft. Install the adjusting screw cage part of the preloading tool over the ground sleeve. Install the snap ring on the left end of the ground sleeve.

Note. The part of the tool which is installed in the ground sleeve is spring-loaded to 200 pounds. Do not tighten or loosen the nuts on this part of the tool because this would change the loading on the spring.

Turn the adjusting tool by hand until it seats on the retaining screw head on the other part of the tool. Then turn the adjusting screw one full revolution to assure a load of 200 to 225 pounds on the converter-output-shaft bearing.

Tighten the lock nut on the adjusting screw cage.

- (12) Install the right housing on the left housing.

Note. Do not install the right- and left-steering shafts assembly.

Install the reverse-clutch housing and hub assembly in the right housing to center the output shaft. Secure the right housing to the left housing by installing three bolts in each split line.

- (13) To check for backlash, set up the dial indicator inside the housing by working through the opening in the rear of the housing ((3) above). Inspect the backlash and pattern on the driving gear ((4) above).

Note. The gear rotation is clockwise when viewed from above (fig. 331). Be careful to check the pattern on the driving or concave side of the tooth on the driving bevel gear.

Refer to figure 330. Move each gear, if necessary, by adding or removing shims. Again check the backlash and mesh pattern. Repeat this procedure until a central pattern is obtained with the *minimum* backlash within 0.002 inch of that etched on the gear (L of fig. 330).

- (14) When the proper pattern and backlash have been obtained, add 0.024-inch shims to the driven-gear shim pack that was used to obtain the proper pattern. Add sufficient shims to the driving gear to get a *minimum* backlash of 0.001 to 0.004 inch ((3) above).

Note. This procedure is necessary to keep the tooth bearing or pattern off the heel of the tooth during the operation of the transmission.

- (15) With the left steering-cross-shaft gear and steering differential pinions in place in the left housing, install the steering-differential pinion holding tool on the left housing split line using two bolts. The web on the tool is to be installed between the hubs of the two gear assemblies to take all of the end play out of the bevel pinions (fig. 331). Turn the front thumbscrew down until it engages the front bevel pinion and prevents the pinion from moving.
- (16) Set up a dial indicator to measure the backlash between the left steering-cross-shaft bevel gear and the front bevel pinion ((3) above). Loosen the front thumbscrew and tighten the rear thumbscrew. Check the backlash between the left steering-cross-shaft-bevel gear and the rear bevel pinion. Loosen the rear thumbscrew.
- (17) Paint the teeth of the front- and rear-bevel pinion for a mesh pattern check ((4) above). Since the left steering-cross-shaft gear may be driven by either pinion, each pinion must be rotated in a clockwise direction (viewed from the rear of the transmission) for the mesh pattern check. Inspect the pattern on the drive side of the teeth on the pinions. The desired pattern on the pinions is central toe and slightly on the addendum or face of the tooth (B of fig. 330).

Note. Since the gear is only slightly larger than the pinions, any shift in the gear mounting will affect the pattern as well as the backlash. Any shift in position of the pinions will affect backlash as well as pattern.

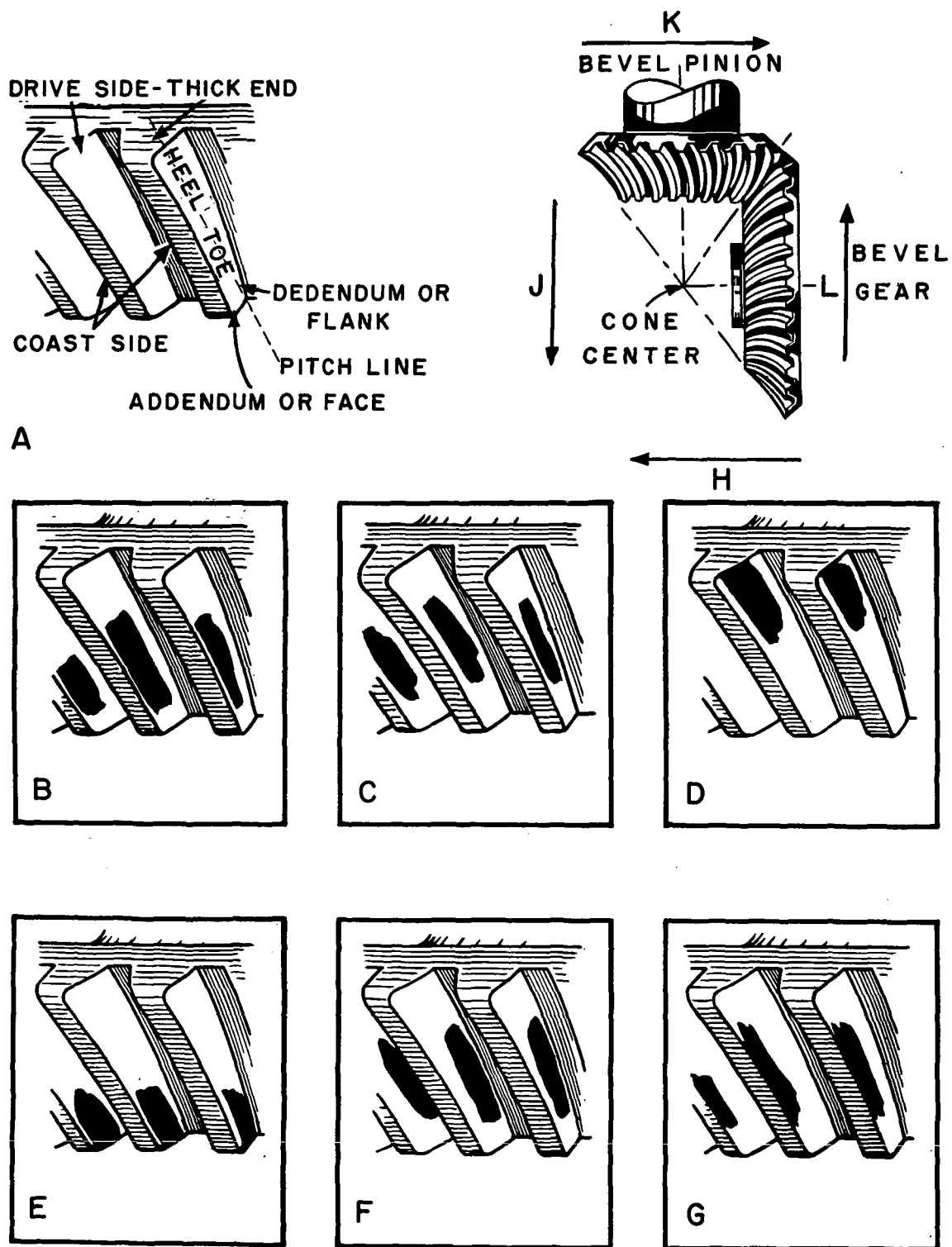
- (18) Shift the positions of the gears as necessary to obtain the correct pattern and

the backlash that is etched on the gear. There must not be more than 0.003-inch difference in the two minimum backlash measurements when the correct adjustment has been made. Remove the steering-differential-pinion holding tool.

- (19) With the right steering-cross-shaft bevel gear properly installed in the right housing, install the right housing on the left housing. Install three bolts through the split line on each side of the housing.
- (20) Clamp a short bar to the right steering cross shaft so that it is at right angles with the shaft. Set up a dial indicator so that the stem of the indicator bears on the bar at a point 2 inches from the center of the shaft (fig. 332). Be sure that the stem of the indicator lies in the plane or path of rotation of the bar when the shaft is rotated. Be sure the indicator stem is perpendicular to the bar.
- (21) Prevent the left steering-cross-shaft gear from rotating by blocking it and the rear bevel pinion with a screwdriver. Turn the right steering-cross-shaft by hand to check the backlash being careful to take hold of the shaft as near to the housing as possible. Be sure to lift up on the shaft as the check is being made. Block the front bevel gear and repeat the backlash check. The proper backlash is etched on the right steering-cross-shaft gear.

Note. The greatest backlash between a steering-cross-shaft gear and a differential pinion must not exceed the least backlash between a gear and pinion by more than 0.003 inch.

- (22) If the backlash between the right steering-cross-shaft gear and the bevel pinions is not in limits, remove the right housing. Obtain the correct backlash by installing or removing shims in the right steering-cross-shaft shim pack. In this case removing a 0.001-inch shim will usually increase the backlash approximately 0.00075 inch. For example to increase backlash 0.005 inch, remove 0.007-inch of shims. Install the right housing on the left housing again and check the backlash as in (20) and (21) above.



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Figure 330. Bevel gear mesh pattern.

- A—Check the adjustments at the drive side of the bevel gear tooth.
- B—Shows the central toe addendum tooth pattern for the steering-differential bevel pinions and for the input *driving* bevel gear.
- C—Shows the central tooth pattern for the converter output *driving* bevel gear before adding 0.024-inch shim to the converter output *driven* gear.
- D—Shows a short pattern on the heel. Move the pinion toward the gear to correct this condition. Then move the gear away from the pinion to obtain the correct backlash.
- E—Shows a short pattern on the toe. Move the pinion away from the gear to correct this condition. Then move the gear toward the pinion to obtain the correct backlash.
- F—Shows a heavy pattern on the flank or dedendum of the tooth. Move the gear toward the pinion to correct this condition. Then move the pinion away from the gear to obtain the correct backlash.
- G—Shows a heavy pattern on the face or addendum of the tooth. Move the gear away from the pinion to correct this condition. Then move the pinion toward the gear to obtain the correct backlash.
- H—Move the gear in this direction to correct the condition shown at F.
- J—Move the pinion in this direction to correct the condition shown at D.
- K—Move the gear in this direction to correct the condition shown at G.
- L—Move the pinion in this direction to correct the condition shown at E.

Figure 330—Continued.

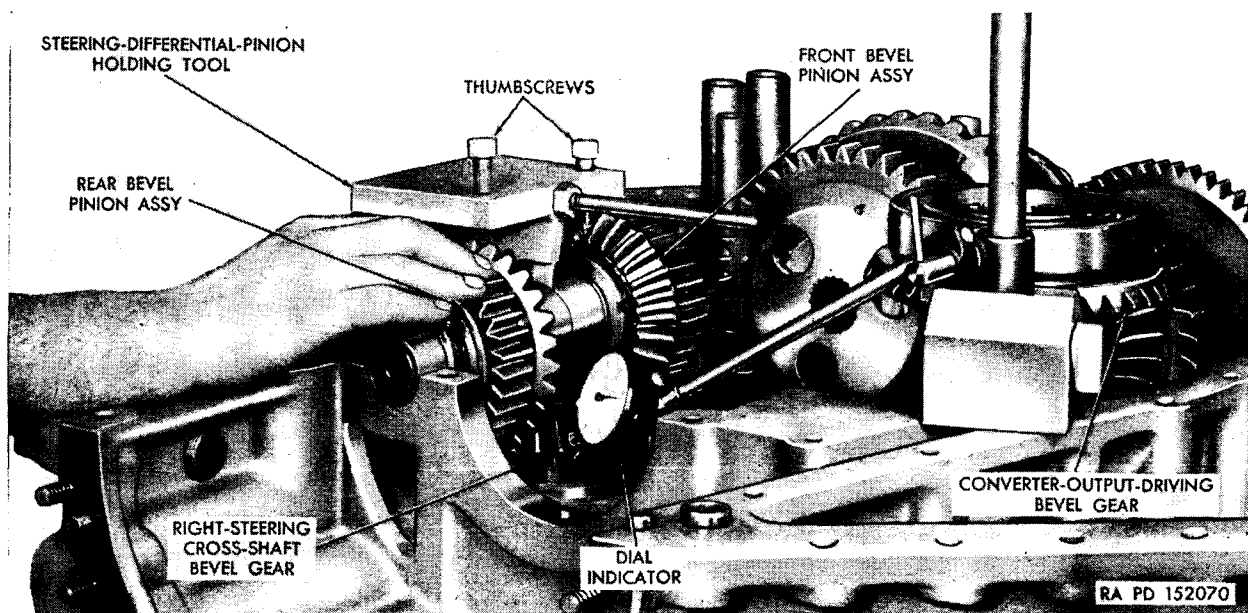


Figure 331. Steering-differential-bevel-pinion and gear backlash check.

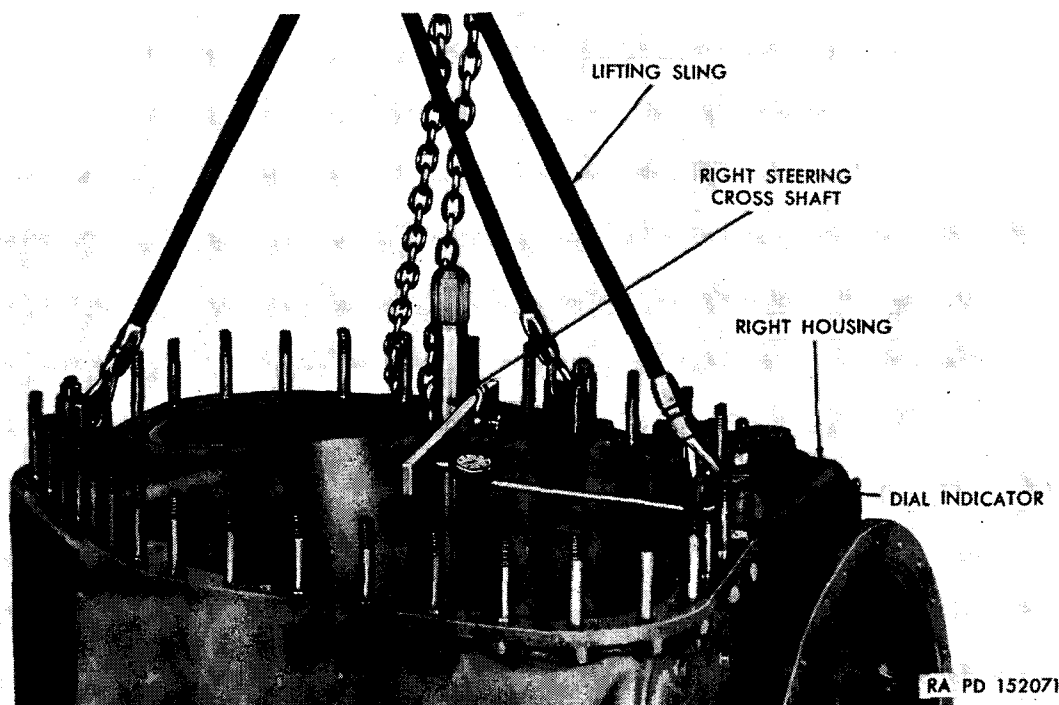


Figure 332. Right-steering-cross-shaft backlash check.

Section XII. REBUILD OF RIGHT HOUSING

60. Disassembly of Right Housing

- a. Place the right housing on the assembly table.
- b. Remove the cotter pins from the four castellated nuts which secure the right steering cross shaft assembly to the housing. Using a $\frac{1}{2}$ -inch wrench, remove the nuts and pull the shaft assembly out of the housing (fig. 333). Using two $\frac{3}{8}$ -inch jack screws, separate and remove the bearing cage from the housing (fig. 334). Remove the shims from the steering-cross-shaft to housing studs. Wire the shims to the bearing cage for safekeeping.
- c. Using a $\frac{1}{2}$ -inch wrench, remove the bolt from the input-bevel-gear oil nozzle (fig. 335). Remove the nozzle from the housing. Using the adapter (41-A-18-380) and remover (41-R-2373-216), remove the main-pressure relief valve (fig. 336). Remove the low-range-jumper-tube plug from the housing using a bolt, pliers and a hammer (fig. 337). Using the adapter (41-A-18-385) and remover (41-R-2373-216), pull the jumper tube out of the housing (fig. 338).
- d. Using a $\frac{3}{4}$ -inch wrench, remove the three bolts and washers from the low-range clutch accumulator. Remove the accumulator from the housing (fig. 339). Remove the oil filler cap.

Using a screwdriver to turn the oil filler screen, loosen and remove the screen from the housing (fig. 340).

61. Cleaning

Refer to paragraph 25 for cleaning instructions.

62. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for general inspection and repair procedure. Refer to paragraph 103 for serviceability measurements and wear limits.

b. RIGHT HOUSING (fig. 314).

- (1) Check to see that the low-range-clutch orifice and steering-overspeed-limit-pump-pressure orifice are free of obstructions (fig. 336).
- (2) Inspect the four "O" ring gaskets on the right housing to left housing split line for defects (fig. 341). Inspect the three "O" ring gaskets on the housing to end plate split line for defects (fig. 342). Do not remove the accumulator plate unless it is defective. Inspect the "O" ring gasket on the oil-filler neck for defects.

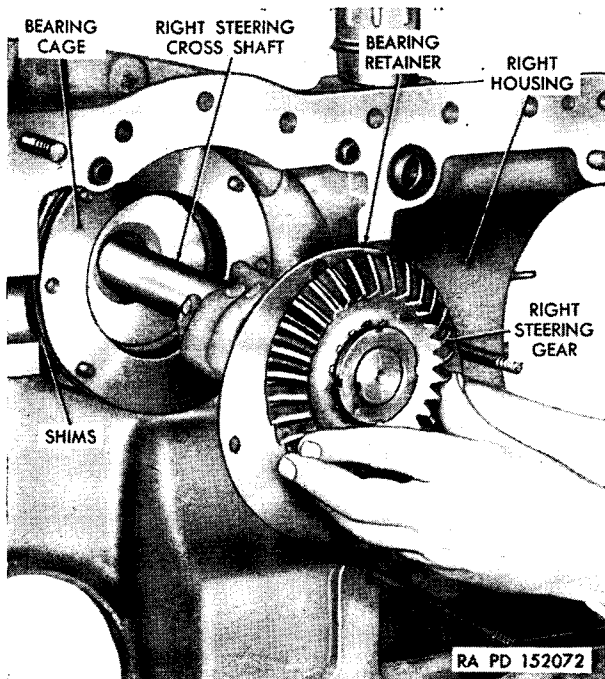


Figure 333. Removing or installing right steering cross shaft assembly.

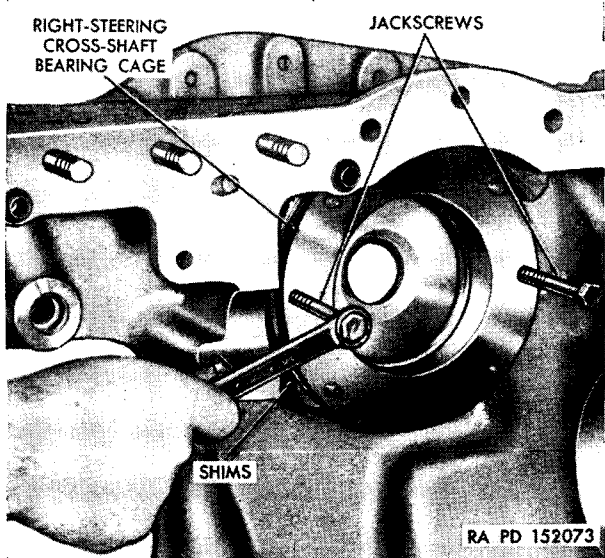


Figure 334. Removing right steering-cross-shaft bearing cage.

- (3) Inspect the steering-clutch-coolant-pump pick-up tube and gasket for defects (fig. 348). If the tube or gasket is defective they may be removed by first driving the oil-transfer tube out of the housing,

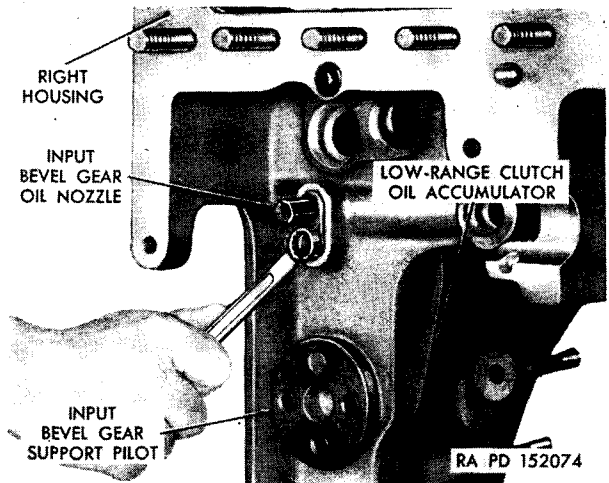


Figure 335. Removing or installing input-bevel-gear oil nozzle.

and then removing two screws from the pick-up tube. Remove the pick-up tube gasket, and ring from the housing (fig. 343).

- (4) Assemble the tube to the housing by installing the gasket on the tube. Install the tube in the housing. Install the ring over the tube on the inside of the housing. Be sure all of the holes are aligned. Install two screws and stake them securely to the pick-up-tube flange. Replace the oil transfer tube in the housing.

c. OIL FILLER SCREEN (fig. 314). Inspect the oil-filler-neck cap assembly for dents or a damaged inner gasket or bent oil-level indicator. Replace the assembly if any part of it is defective. Inspect the cap outer gasket on the filler neck. Inspect the oil-filler screen for loose or broken soldered joints. Replace any defective parts.

d. RIGHT STEERING CROSS SHAFT (fig. 258).

- (1) Inspect the right steering cross shaft and bearing assembly for defects in the gear, bearing or shaft. If disassembly is necessary, bend back the tab on the lock washer. Using spanner wrench (41-W-3736-280), remove the lock nut. (Refer to figure 278 for use of this wrench.) Remove the tabbed lock washer, and the bevel gear and bearing assembly. Press the gear out of the bearing and remove the bearing retainer.

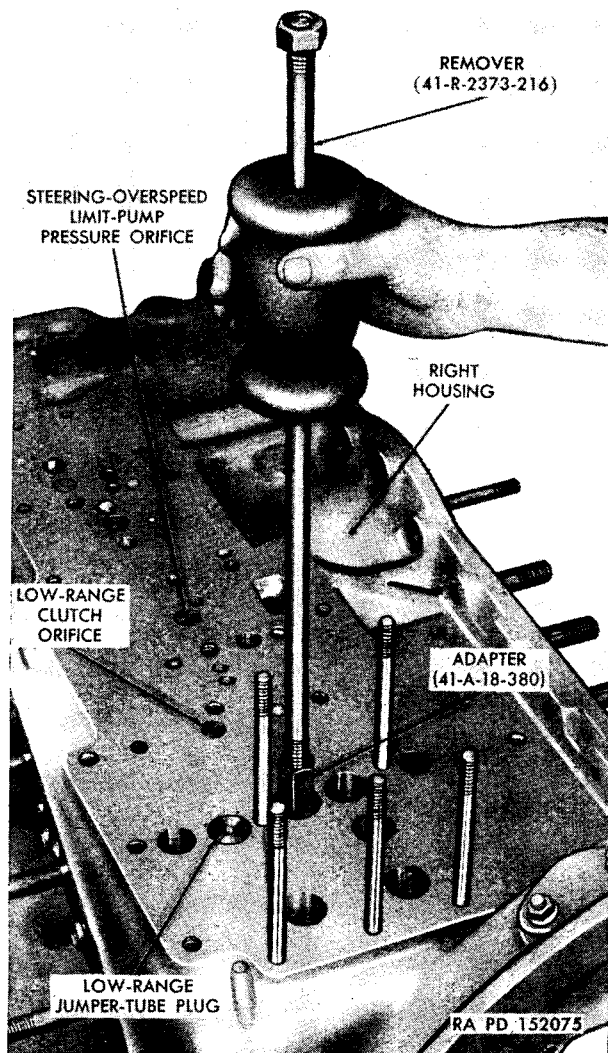


Figure 336. Removing main pressure relief valve.

- (2) Inspect the right steering-cross-shaft bearing cage.

Note. If inspection shows the bevel gear to be defective or if any of the other three steering bevel gears have been replaced, it will be necessary to replace the gear. The two steering-differential bevel pinions, the right steering-cross-shaft bevel gear, and the left steering-cross-shaft bevel gear are a matched set of gears. If any gear of the set is defective, the entire set must be replaced.

- (3) If the gear or the bearing cage has not been replaced, refer to (4) below for the assembly of the right steering cross shaft.

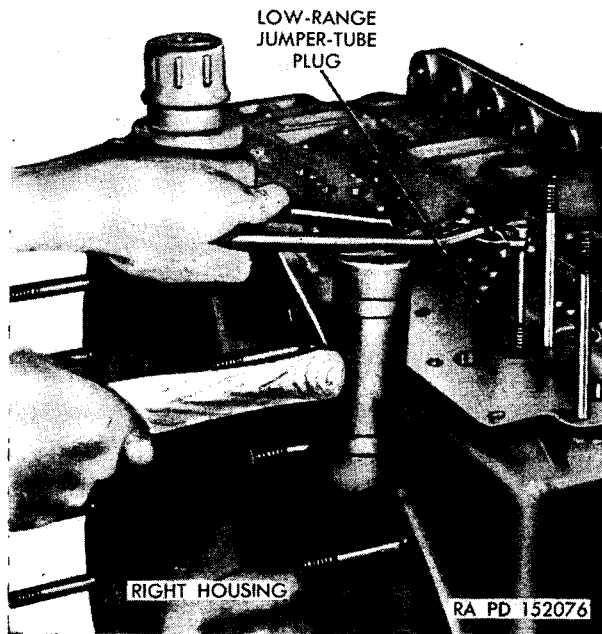


Figure 337. Removing low-range jumper tube plug.

If the gear or the bearing cage has been replaced, it is necessary to determine the correct nominal shim. Refer to paragraph 58b(7) through (9). Measure and record the thickness of the bearing-cage flange. This measurement is dimension *Y* (fig. 263). Add the gear mounting distance, dimension *X*, which is stamped on the gear, to the dimension *Y*. Subtract (*X*+*Y*) from the dimension *D* which is given on the left housing. The result will be the nominal shim pack required: $D - (X + Y) = \text{Shim}$.

- (4) Wire the shim pack to the bearing cage for safekeeping.

Note. If a new shim pack has been made up according to (3) above, dispose of the original shim pack to avoid any possibility of using it in the place of the new shim pack.

To assemble the right steering cross shaft install the bearing retainer over the gear hub and press the bearing onto the gear hub. Be sure that the lettered side of the bearing is installed toward the bearing retainer.

- (5) Install the gear and bearing assembly on the right steering cross shaft. Install the tabbed lock washer and lock nut on

the shaft. Tighten the nut with the spanner wrench (41-W-3736-280) (fig. 278). Bend the tab of the lockwasher over to secure the lock nut.

e. MAIN-PRESSURE RELIEF VALVE (fig. 312). Inspect the relief valve assembly for free action by depressing the ball. If disassembly is necessary, use a screwdriver to remove the plug in the end of the valve body (fig. 344). Remove the spring and ball. Replace any defective parts. To assemble, install the ball, spring, and plug into the relief-valve body. Tighten the plug and stake it securely to the valve body.

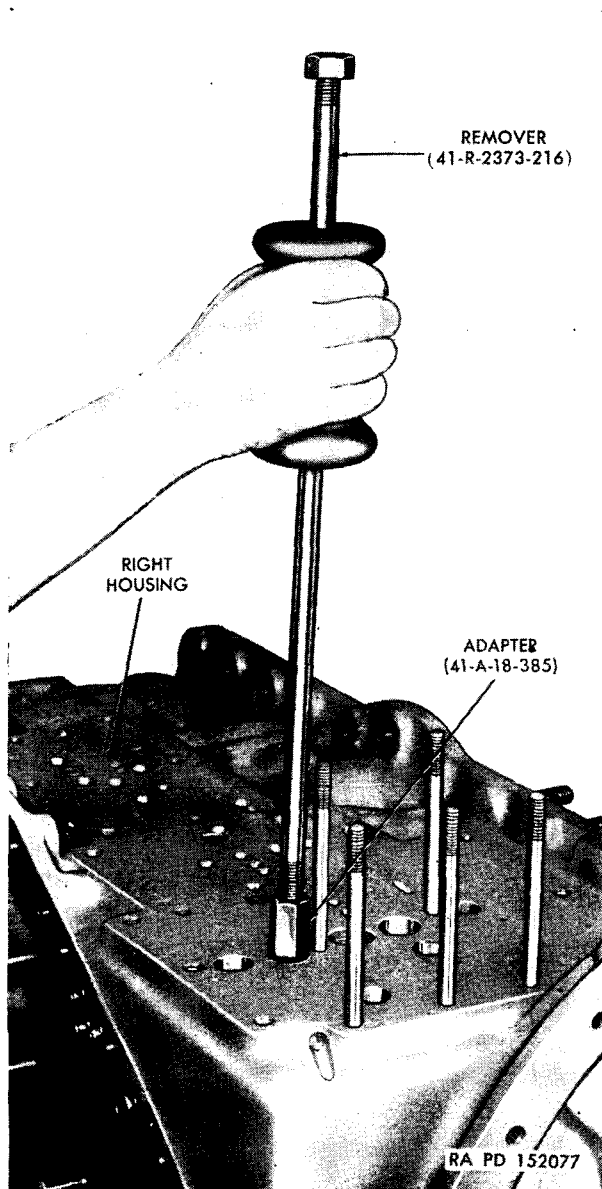


Figure 338. Removing low-range jumper tube.

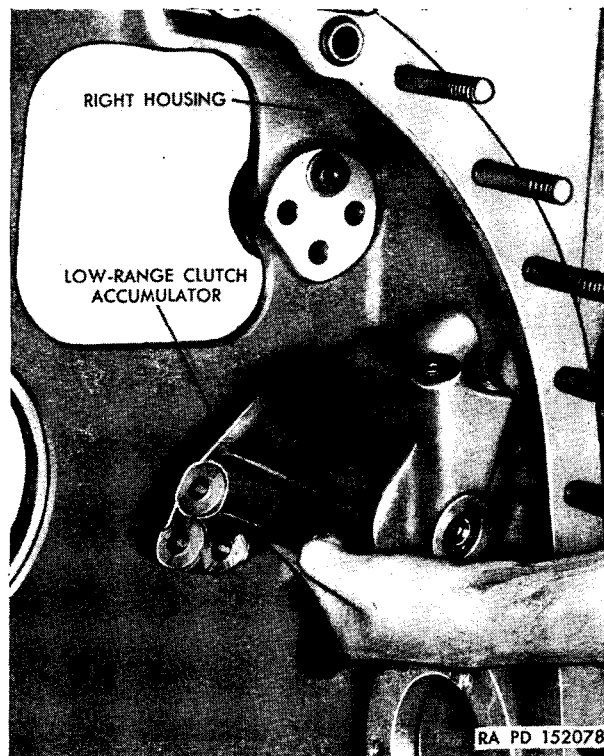


Figure 339. Removing or installing low-range accumulator.

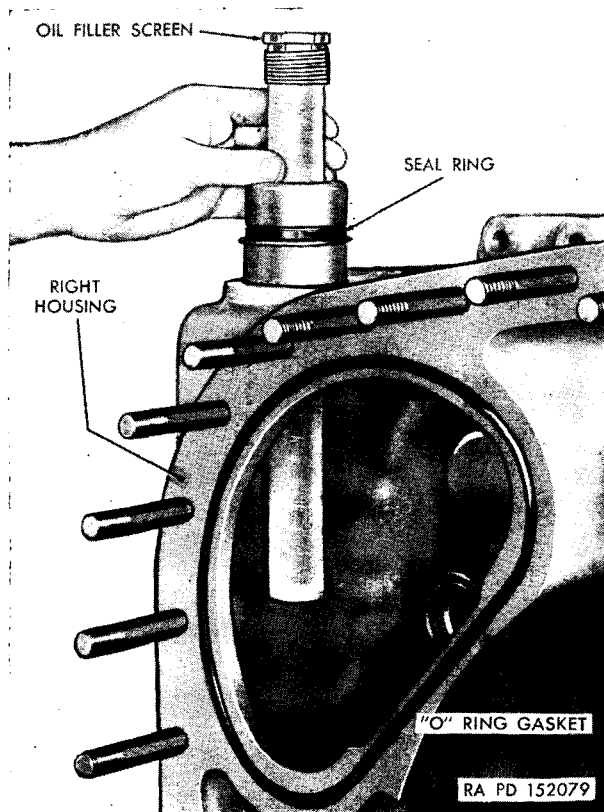
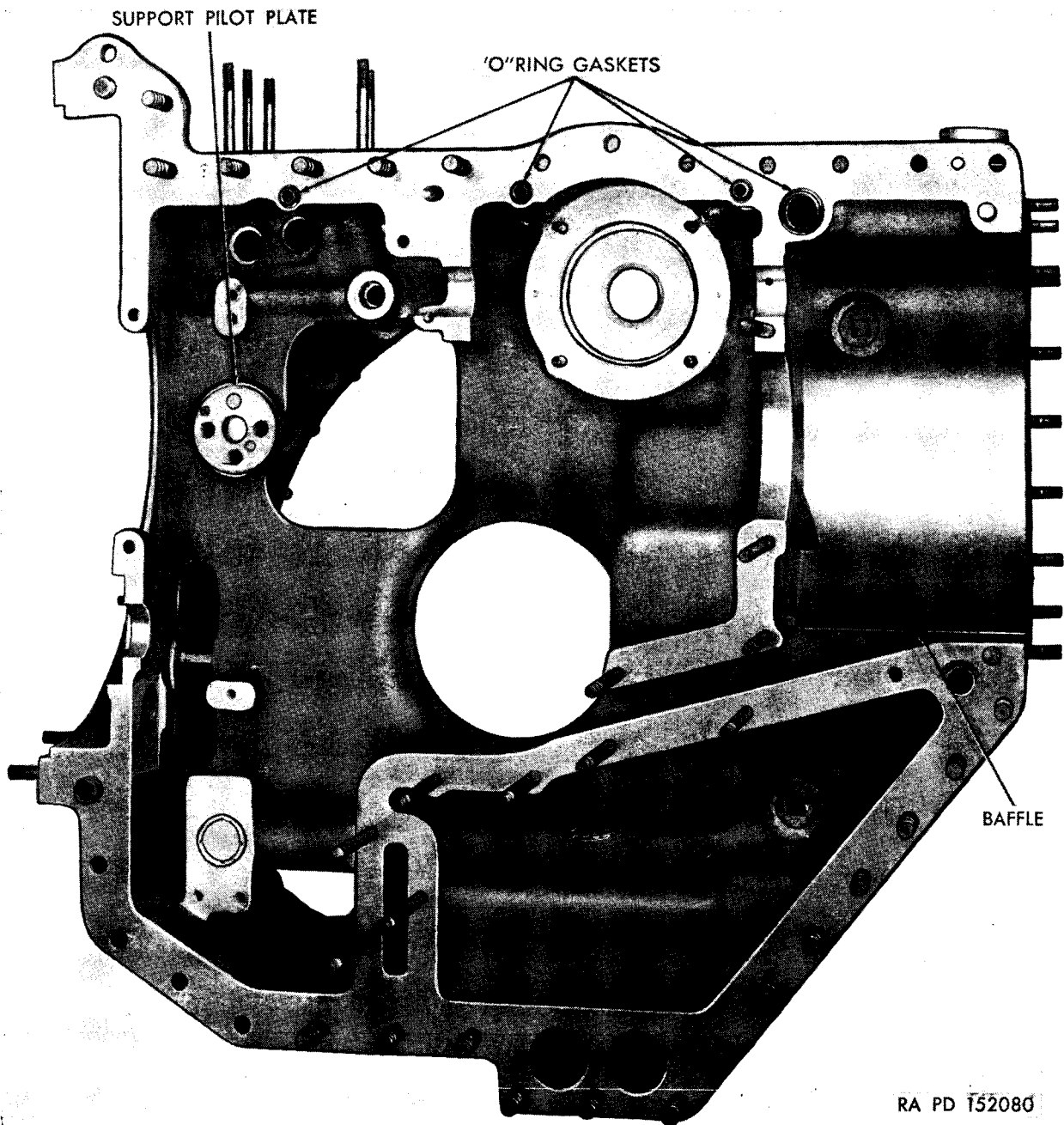
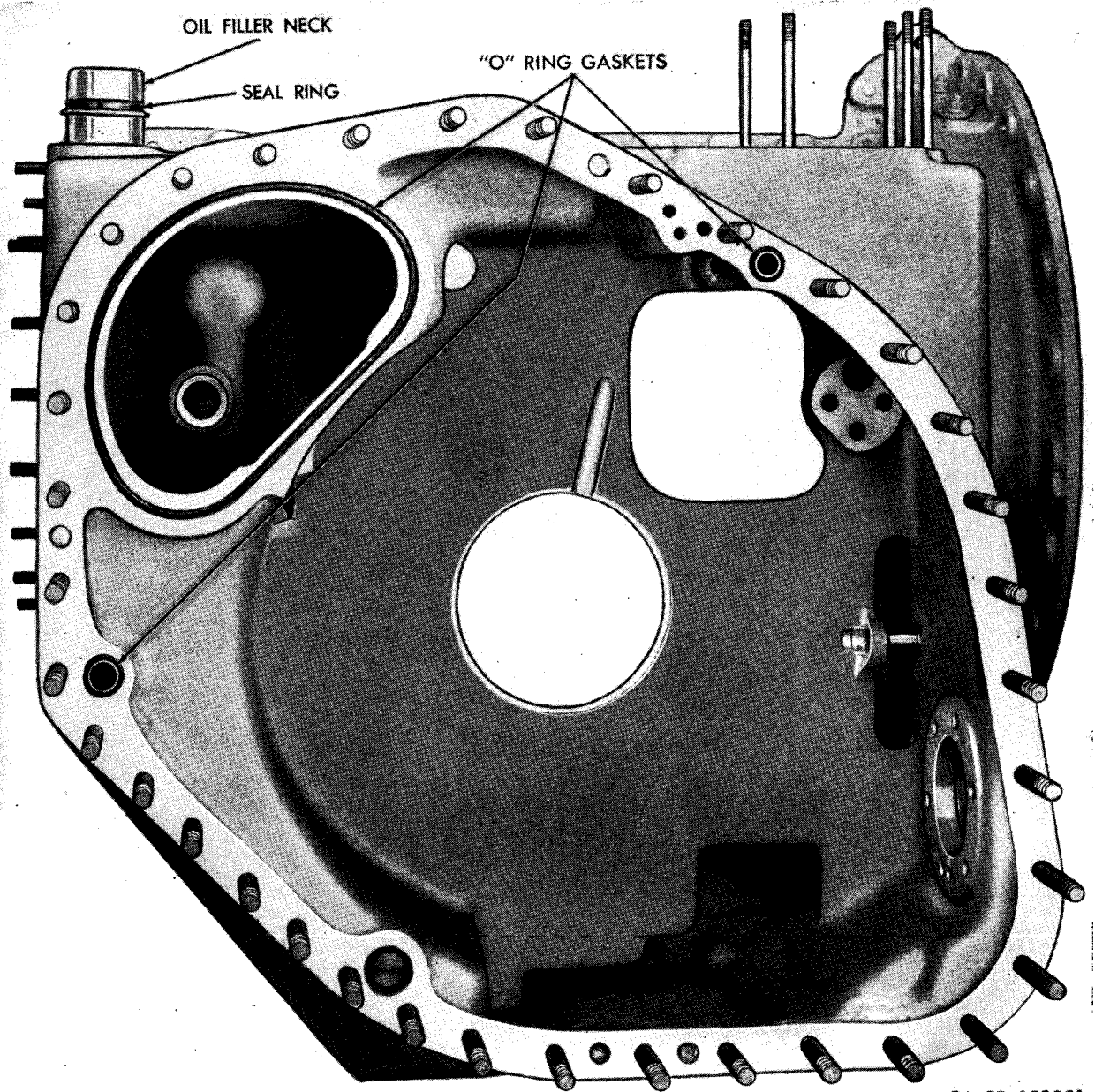


Figure 340. Removing or installing oil filler screen.



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Figure 341. Left side of right housing.



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Figure 342. Right side of right housing.

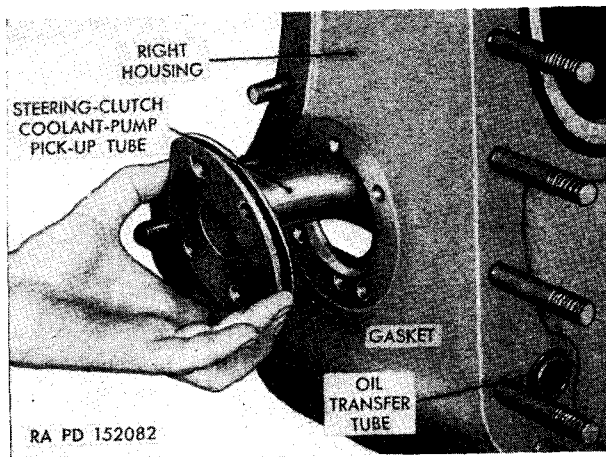


Figure 343. Removing or installing steering-clutch-coolant-pump pick-up tube.

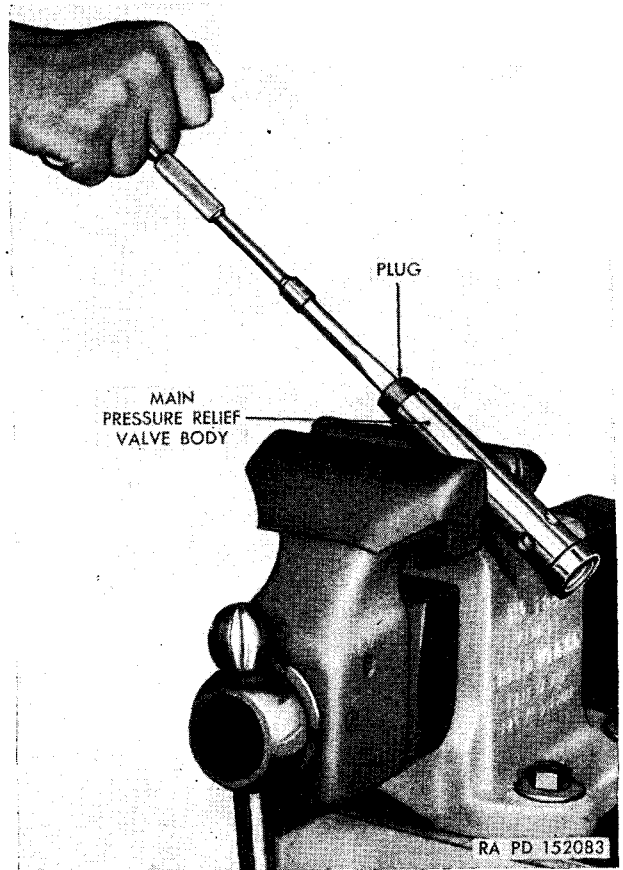
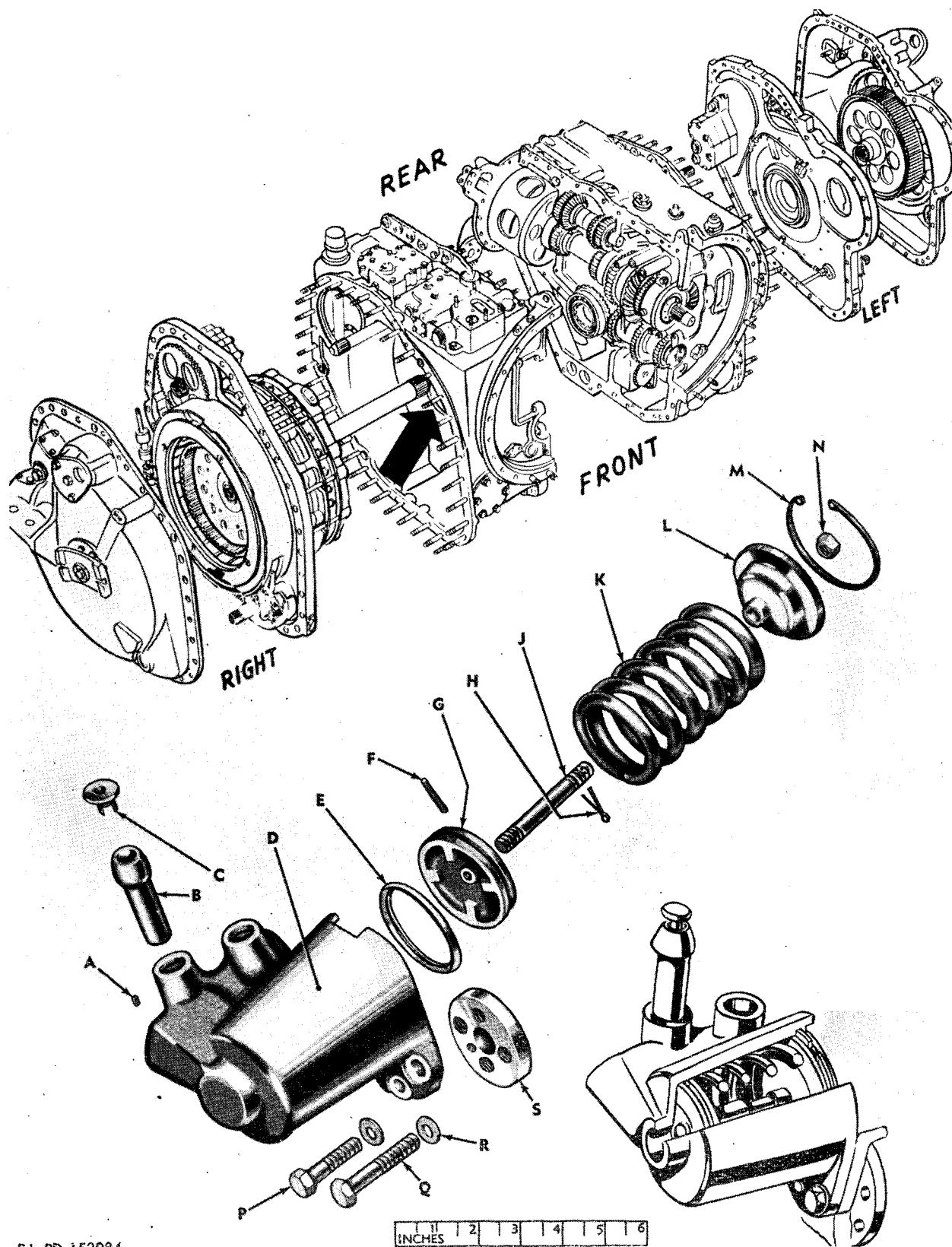


Figure 344. Removing or installing plug from main pressure relief valve.

A—PLUG (2) GM-444693
 B—JUMPER TUBE GM-6765433
 C—PLUG GM-6765435
 D—LOW-RANGE ACCUMULATOR BODY GM-6765348
 E—SEAL RING GM-6765568
 F—DOWEL GM-103678
 G—PISTON GM-6762607
 H—COTTER PIN GM-103373

J—GUIDE GM-6762606
 K—SPRING GM-6762675
 L—SPRING RETAINER PLATE GM-6762632
 M—SNAP RING GM-6762676
 N—NUT GM-119253
 P—BOLT GM-192945
 Q—BOLT (3) GM-220457
 R—WASHER (4) GM-103343
 S—PLATE GM-6760166

Figure 345. Low-range accumulator assembly—exploded view.



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Figure 345—Continued.

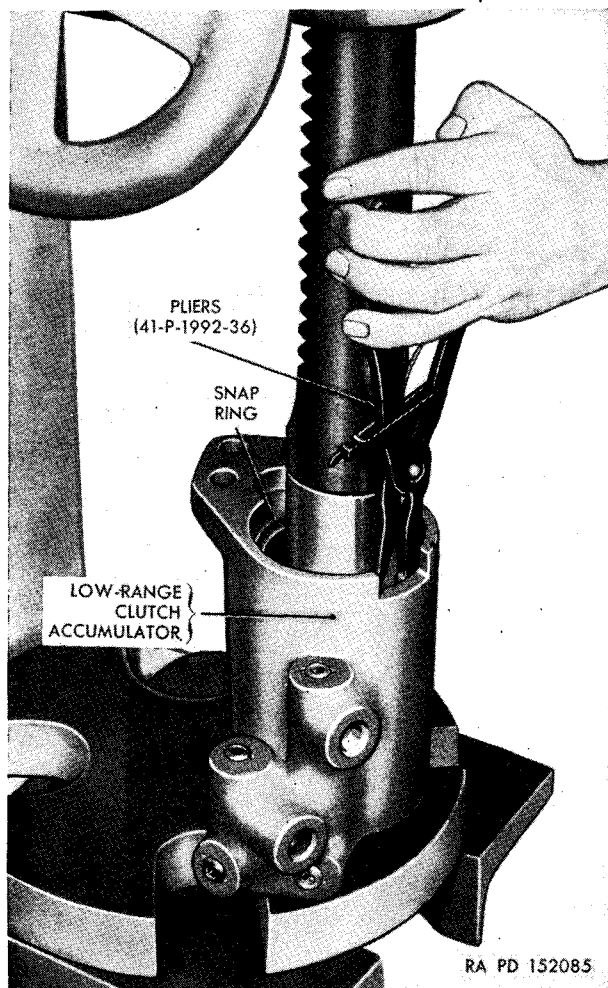


Figure 346. Removing or installing snap ring in low-range accumulator.

f. LOW-RANGE ACCUMULATOR (fig. 345).

- (1) Inspect the low-range-accumulator jumper tube for dents. If it is defective, replace it. Inspect the low-range-accumulator body for cracks.

Note. Unless the body is defective, or there is evidence of malfunction of the accumulator, or there is a possibility that the accumulator has dirt in it due to a transmission part failure, it will not be necessary to disassemble the accumulator.

- (2) If it is necessary to disassemble the accumulator, place it, snap ring side up, in an arbor press. Depress the spring retainer plate enough to take pressure off the snap ring. Using pliers (41-P-1992-36), remove the snap ring (fig. 346). Pull the piston assembly from the ac-

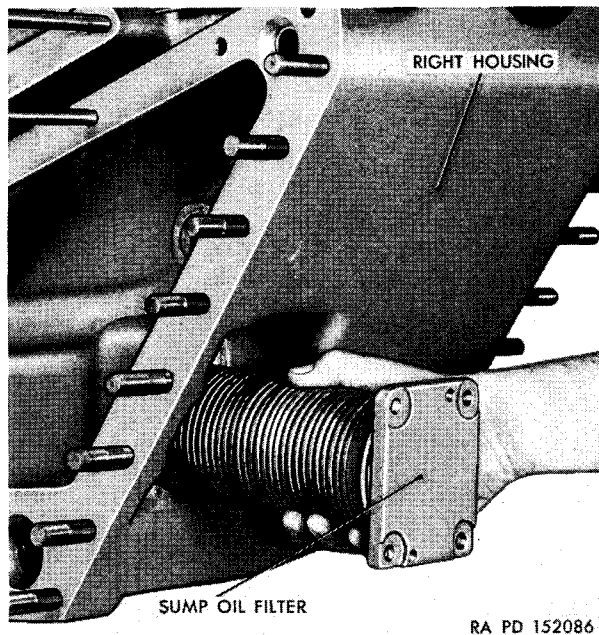


Figure 347. Installing sump oil filter.

cumulator body. Inspect the piston assembly. If the seal ring is defective, replace it.

- (3) If it is necessary to disassemble the piston assembly, remove the cotter pin from the nut. Place the assembly in an arbor press and depress the spring-retainer plate. Remove the nut using a $\frac{3}{8}$ -inch wrench. Gradually reduce the pressure on the spring. Remove the retainer plate and spring from the piston and guide assembly. Replace any defective parts.
- (4) To assemble, install the spring on the piston. Install the spring-retainer plate and the nut. Turn the nut down against the retainer plate until the cotter pin can be installed. Install the cotter pin. Install the piston assembly in the accumulator body, being careful not to roll the lip of the seal ring. Compress the spring and install the retaining snap ring.

63. Assembly of Right Housing

a. Place the right housing, top side up, on the assembly table. Install the sump oil filter making sure the "O" ring gasket is in place on the filter assembly (fig. 347). Secure the filter assem-

bly to the housing with four $\frac{5}{16}$ -inch bolts and washers. Torque the bolts to 17 to 20 pound-feet.

b. Install the oil filler screen in the filler neck using a screwdriver (fig. 340). Install the filler neck cap and indicator assembly. Install the low-range accumulator securing it to the housing with three $\frac{1}{2}$ -inch bolts and washers. Torque the bolts to 67 to 80 pound-feet.

c. Install adapter (41-A-18-380) in the main pressure relief valve. Install the relief valve in its bore in the housing. Seat the valve by tapping on the adapter with a soft hammer. Install the adapter (41-A-18-385) in the low range accumulator jumper tube. Install the jumper tube in the

housing, seating the tube by tapping on the adapter with a soft hammer. Install the plug over the low range accumulator jumper tube using a soft drift and hammer. Secure the plug by staking. Install the input-bevel-gear oil nozzle, securing it to the housing with one $\frac{5}{16}$ -inch bolt (fig. 335). Torque the bolt to 17 to 20 pound-feet.

d. Install the proper shims on the steering cross shaft bearing cage to housing studs. Install the bearing cage on the studs. Install the right steering cross shaft and bearing assembly in the cage (fig. 333) and secure it to the housing with four $\frac{5}{16}$ -inch castellated nuts. Torque the nuts to 9 to 11 pound-feet and install cotter pins.

Section XIII. REBUILD OF STEERING-CLUTCH COOLANT PUMP

64. Disassembly of Steering-Clutch Coolant Pump

(fig. 348).

Remove two screws (H of fig. 348) from the steering-clutch coolant pump body, using a screwdriver. Lift the body from the cover (fig. 349). Lift the outer rotor from the pump cover (fig. 350). Remove the inner rotor from the cover.

65. Cleaning

Refer to paragraph 25 for cleaning instructions.

66. Inspection and Repair

a. GENERAL. Refer to paragraphs 26a through 26d for general inspection and repair procedure. Re-

fer to paragraph 104 for serviceability measurements and wear limits.

b. BEARING. If the ball bearing (C of fig. 348) in the pump cover is defective, pry it out. Install a new bearing using an arbor press or drift.

67. Assembly of Steering-Clutch Coolant Pump

Install the inner rotor in the steering-clutch coolant pump cover. Install the outer rotor over the inner rotor (fig. 350). Install the "O" ring gasket in the pump cover. Install the body on the cover (fig. 349). Install two $\frac{1}{4}$ -inch screws (H of fig. 348) in the steering-clutch coolant pump body.

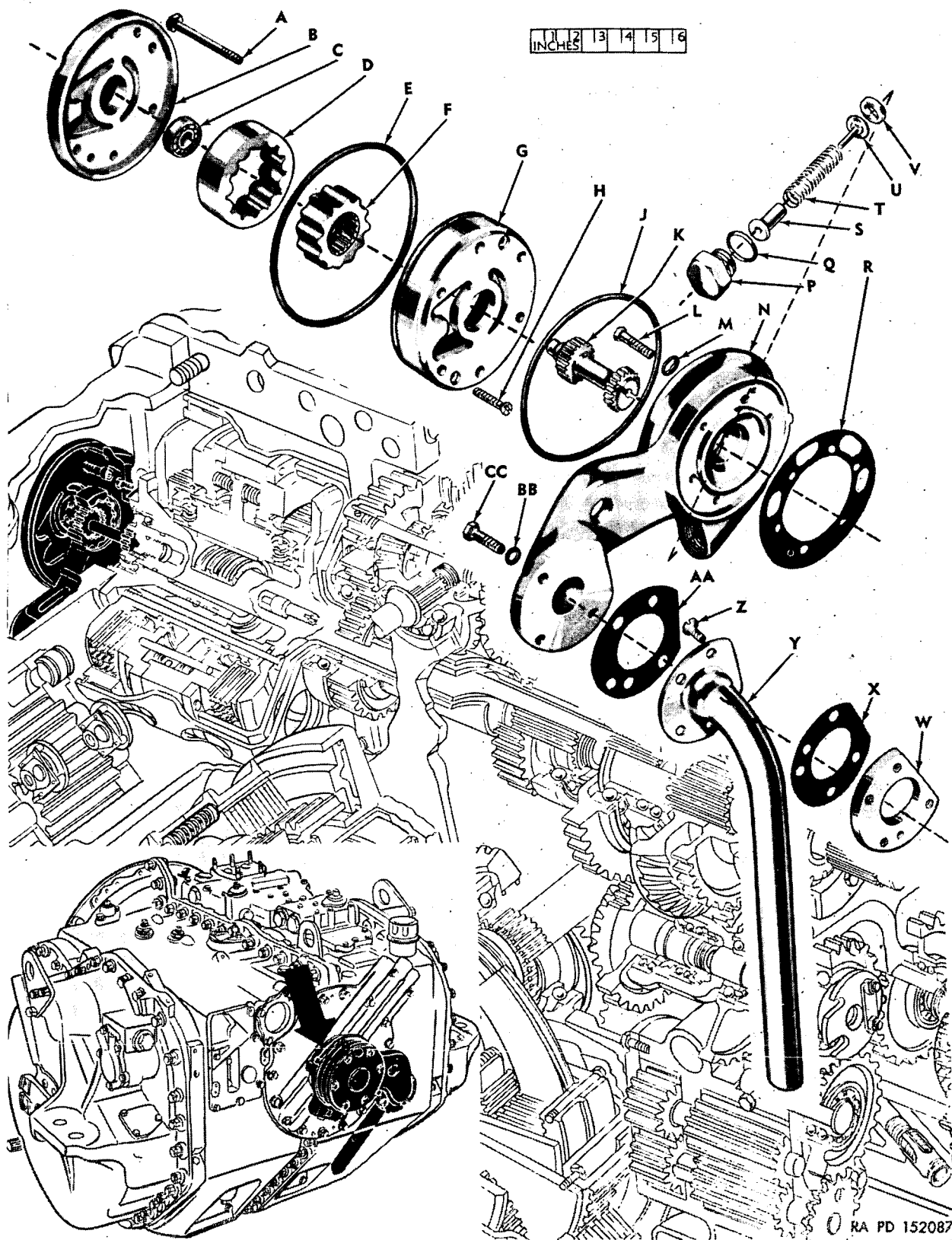


Figure 348. Steering-clutch coolant pump, manifold, regulator valve and pick-up tube—exploded view.

A—BOLT (6) GM-6763839
 B—STEERING CLUTCH COOLANT PUMP COVER GM-6765375
 C—BALL BEARING GM-954498
 D—OUTER ROTOR GM-6765373
 E—"O" RING GASKET GM-6760496
 F—INNER ROTOR GM-6765374
 G—STEERING CLUTCH COOLANT PUMP BODY GM-6765376
 H—SCREW (2) GM-114360
 J—"O" RING GASKET GM-6760496
 K—STEERING CLUTCH COOLANT PUMP SHAFT GM-6765372
 L—BOLT (6) GM-221587
 M—WASHER (6) GM-103340
 N—STEERING CLUTCH COOLANT PUMP MANIFOLD GM-6765383
 P—REGULATOR VALVE CAP GM-6765395
 Q—SEAL RING GM-6765399
 R—STEERING CLUTCH SLEEVE GASKET GM-6765390
 S—GUIDE GM-6765394
 T—SPRING GM-6763927
 U—COOLANT PUMP REGULATOR VALVE GM-6766190
 V—SEAT GM-6765384
 W—SUCTION PIPE RING GM-6765388
 X—SUCTION PIPE GASKET GM-6765390
 Y—COOLANT PUMP PICK-UP TUBE GM-6765385
 Z—SCREW (2) GM-420623
 AA—MANIFOLD GASKET GM-6765390
 BB—WASHER (3) GM-103340
 CC—BOLT (3) GM-6762888

Figure 348—Continued.

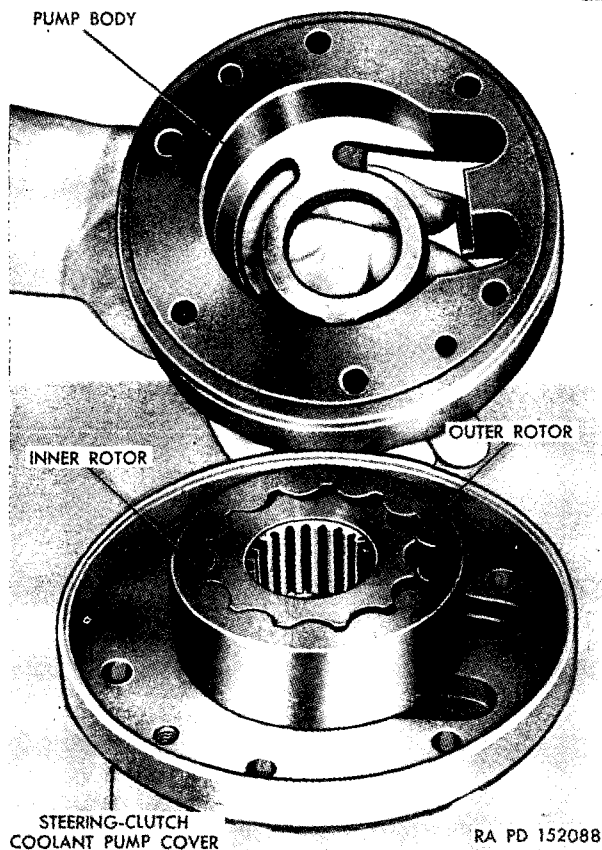


Figure 349. Removing or installing coolant pump body.

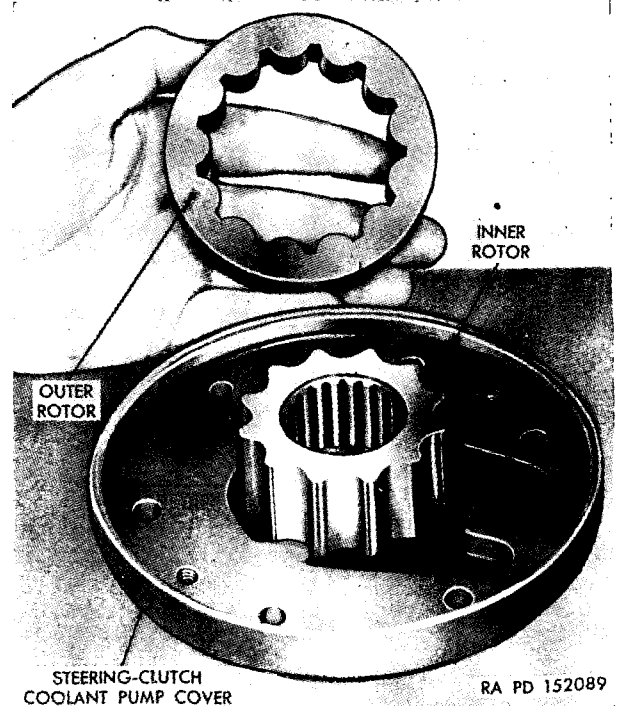


Figure 350. Removing or installing coolant-pump outer rotor.

Section XIV. REBUILD OF INPUT SCAVENGE AND CONVERTER CIRCULATING PUMP

68. Disassembly of Input Scavenge and Converter Circulating Pump

a. Remove the jumper tube and two "O" ring gaskets from the pump body. Using a $\frac{1}{2}$ -inch wrench, remove the bolt which retains the pump-idler-gear shaft.

b. Remove the idler gear, the bearing, the shaft and spacer as an assembly. Using a $\frac{1}{2}$ -inch wrench, remove the four bolts from the pump rear cover and remove the cover (fig. 351). Remove the converter-pump-idler gear. Remove the snap ring (fig. 352) from the drive gear shaft. Remove the converter-circulating-pump-drive gear and retaining roller from the pump drive shaft (fig. 353).

c. Remove the four bolts from the oil pump front cover (fig. 354). Loosen the front cover by tapping lightly on the idler-gear shaft. Remove the cover, the drive shaft, the scavenge-pump drive gear, the idler gear, and the idler shaft as an assembly. Remove the idler gear from the idler shaft (fig. 355).

d. Pull the scavenge-pump-internal drive gear off the drive shaft and remove the two gear-retaining rollers from the groove on the drive shaft (fig. 356).

Note. If the drive gear is tight on the drive shaft, tap the shaft out of the gear so as not to damage the drive-shaft bushing in the front cover with the gear retaining rollers.

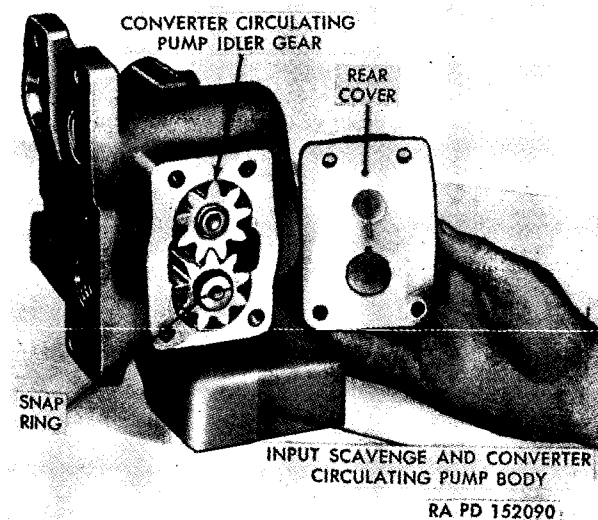


Figure 351. Removing or installing rear cover of input scavenge and converter circulating pump.

Remove the drive shaft from the cover (fig. 357). Tap the idler shaft out of the cover being careful not to lose the retaining ball.

69. Cleaning

Refer to paragraph 25 for cleaning instructions.

70. Inspection and Repair

a. GENERAL. Refer to paragraphs 26a through l for general inspection and repair procedure. Refer to paragraph 105 for serviceability measurements and wear limits.

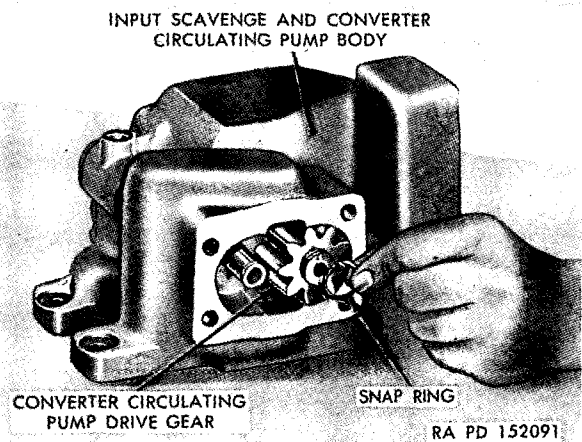


Figure 352. Removing or installing converter-circulating-pump-drive-gear snap ring.

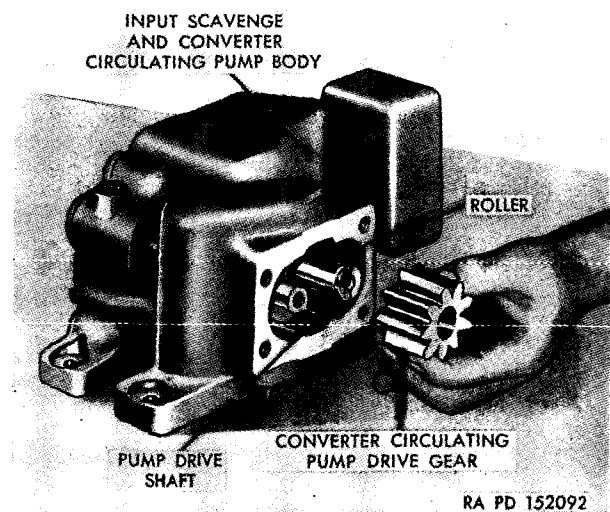


Figure 353. Removing or installing converter-circulating-pump drive gear.

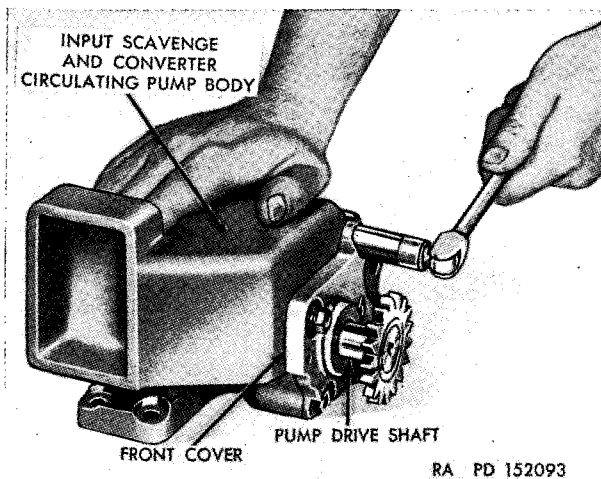


Figure 354. Removing or installing front cover bolts of input scavenge and converter circulating pump.

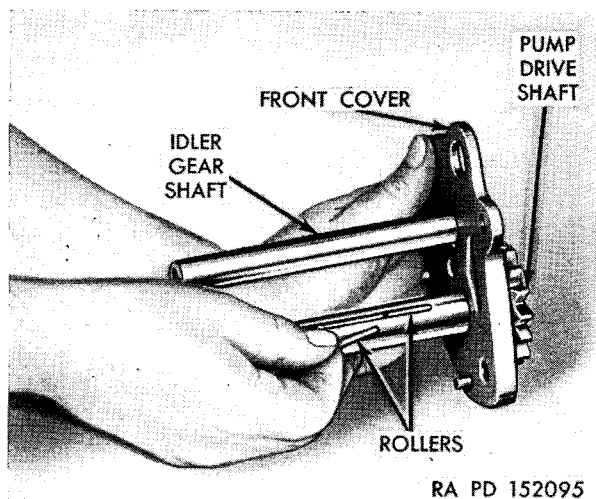


Figure 356. Removing or installing drive-gear-retaining rollers.

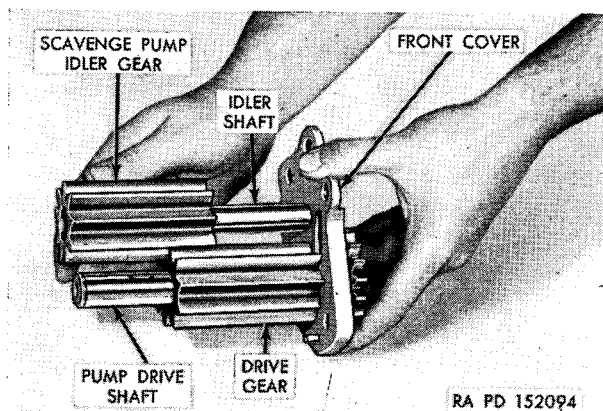


Figure 355. Removing or installing input-scavenge-pump idler gear.

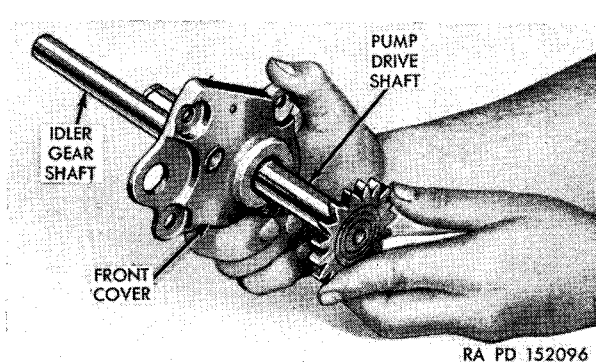


Figure 357. Removing or installing input-scavenge and converter-circulating-pump drive shaft.

b. PUMP BODY AND COVERS (fig. 358).

- (1) Inspect all mating surfaces for burrs which would cause oil leakage. Replace the parts if they cannot be repaired.
- (2) Inspect the bushing in the pump body and the bushing in the front cover for defects. If they are defective and cannot be repaired, press out the bushings and install new ones with an arbor press. Ream the bushings to the proper size (par. 105).
- (3) Replace the two dowels in the front cover if they are defective.

c. GEARS AND SHAFTS.

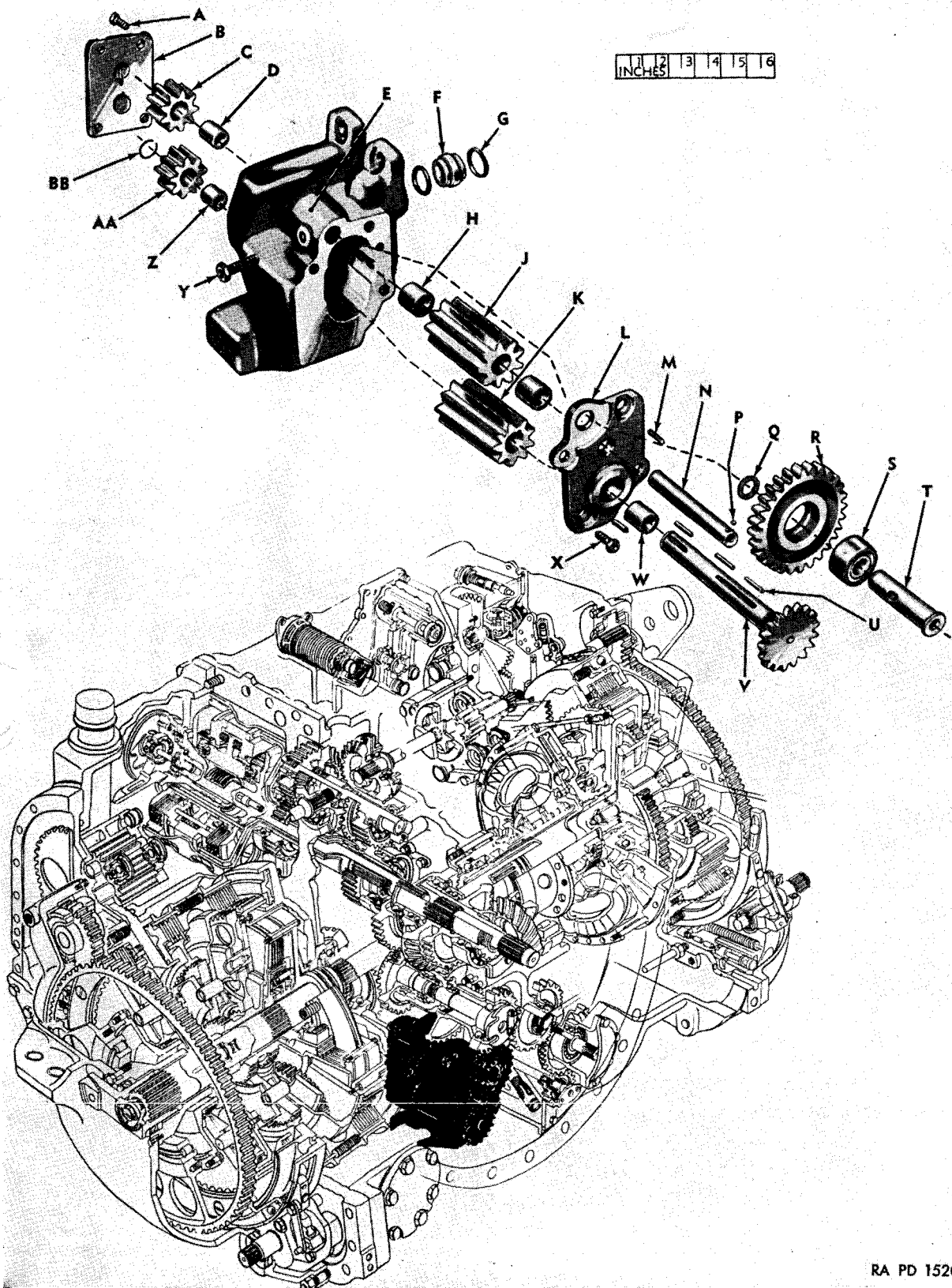
- (1) Inspect the pump-drive-idler gear and bearing assembly for defects. If either the gear or the bearing is defective, press

the shaft out of the bearing and replace the gear and bearing as an assembly. Replace the spacer if it is worn.

- (2) Inspect the drive shaft and drive gears for burrs in the roller grooves. If burrs are found, remove them with a soft stone. Inspect the three rollers for burrs. If there are burrs, replace the rollers.
- (3) Inspect the idler-gear bushings for defects. If the bushings are defective, press them out and install new ones using an arbor press. Ream the bushings to the proper size (par. 105).

71. Assembly of Input Scavenge and Converter Circulating Pump

- a. Install the idler-gear shaft and retaining ball in the pump-front cover (fig. 359). Install the pump drive shaft in the cover (fig. 357). Install



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Figure 358. Input scavenge and converter circulating pump assembly—exploded view.

A—BOLT (4) GM-192099
B—PUMP REAR COVER GM-6765640
C—CONVERTER CIRCULATING PUMP IDLER GEAR GM-6765589
D—BUSHING GM-6760678
E—BODY GM-6765637
F—JUMPER TUBE GM-6762497
G—"O" RING GASKET (2) GM-6762127
H—BUSHING (2) GM-6760678
J—SCAVENGE PUMP IDLER GEAR GM-6765588
K—SCAVENGE PUMP DRIVE GEAR GM-6765587
L—PUMP FRONT COVER GM-6765633
M—DOWELL (2) GM-141151
N—IDLER SHAFT GM-6765635
P—BALL GM-147483
Q—SPACER GM-6765628
R—PUMP IDLER GEAR GM-6765630
S—BEARING GM-905203
T—PUMP IDLER GEAR SHAFT GM-6765636
U—ROLLER (3) GM-6765343
V—PUMP DRIVE SHAFT GM-6765632
W—BUSHING GM-6765629
X—BOLT (4) GM-192099
Y—BOLT GM-429002
Z—BUSHING GM-6765629
AA—CONVERTER CIRCULATING PUMP DRIVE GEAR GM-6765484
BB—SNAP RING GM-6765607

Figure 358—Continued.

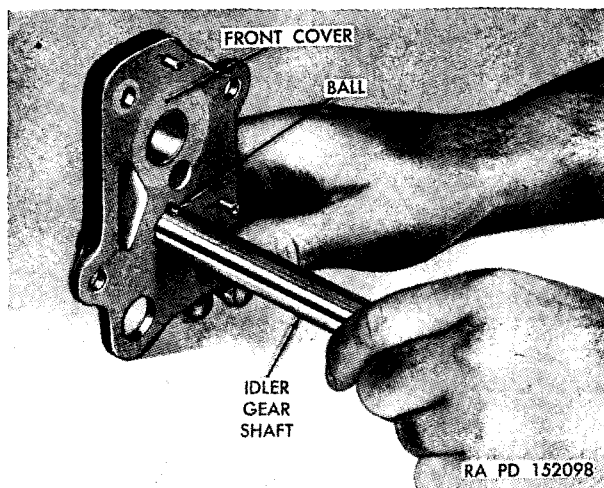


Figure 359. Installing input scavenge and converter circulating pump idler shaft.

two rollers in the long slot on the pump drive shaft (fig. 356). Install the input scavenge-pump gears on the shafts (figs. 355). Install the pump body on the front cover (fig. 360). Install four $\frac{5}{16}$ -inch bolts in the cover and torque 17 to 20 pound-feet (fig. 354).

b. Install the roller and the converter-circulating-pump-drive gear on the drive shaft (fig. 353). Install the snap ring on the end of the drive shaft (fig. 352). Install the converter-circulating-pump-idler gear on the idler gear shaft. Install the pump rear cover on the pump body (fig. 351) making sure that the largest diameter recess in the cover goes over the end of the drive shaft. Install four $\frac{5}{16}$ -inch bolts in the cover and torque 17 to 20 pound-feet.

c. Install the shaft of the pump-drive-idler gear assembly in the bore in the pump body.

Note. Be sure the spacer is on the shaft.

Align the bolt hole in the shaft with the hole in the pump body and install one $\frac{5}{16}$ -inch bolt (fig. 361).

d. Install the "O" ring gaskets on the jumper tube. Install the jumper tube in the pump body.

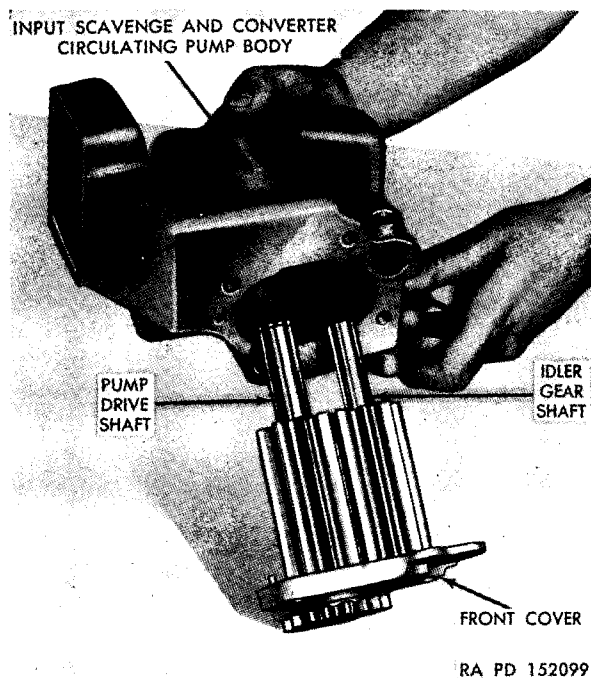


Figure 360. Installing pump body on pump cover.

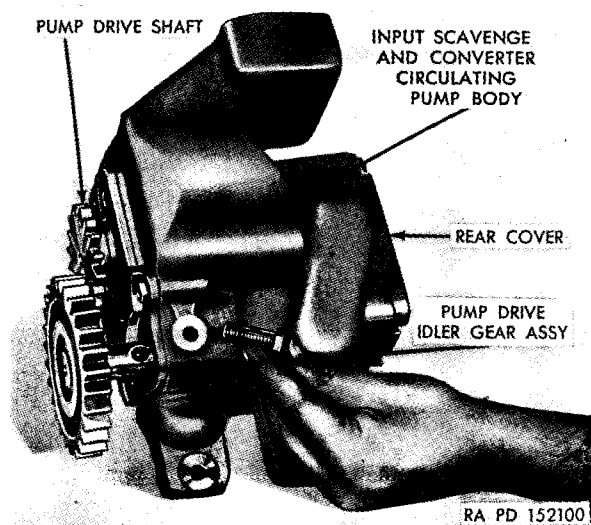


Figure 361. Installing pump-drive idler gear assembly.

Section XV. REBUILD OF INPUT PRESSURE PUMP

72. Disassembly of Input Pressure Pump

Using a $\frac{1}{2}$ -inch wrench, remove the four bolts and washers from the input-pressure-pump cover. Using a soft hammer, lightly tap the pump base to loosen it from the housing. Pull the housing and cover assembly from the base (fig. 362). Remove the pump-internal-drive gear, the idler gear, and the idler-gear shaft from the pump base. Using a soft hammer, separate the pump cover from the housing.

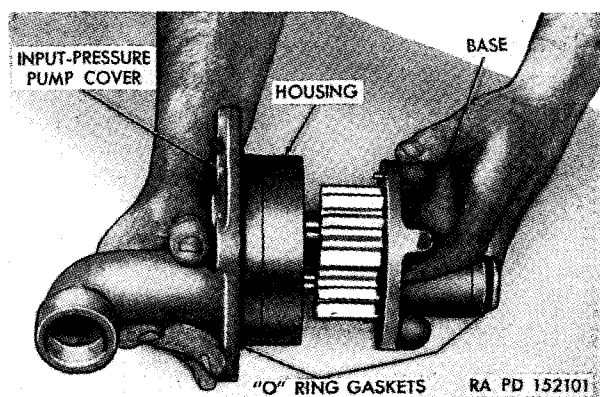


Figure 362. Removing or installing input-pressure-pump housing and cover.

73. Cleaning

Refer to paragraph 25 for cleaning instructions.

74. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for the general inspection and repair procedure. Refer to paragraph 106 for serviceability measurements and wear limits.

b. BUSHINGS (fig. 363). If the bushing in the pump cover or in the base is defective, it must be cut out. If the bushing in the idler gear is defective, press it out. Install new bushings with an arbor press. Ream the bushings to the correct size (par. 106). If the pin in the base is defective, it may be driven out and a new pin installed. Do not remove dowel pins unless they are defective. Refer to paragraph 58l for the inspection of the input-pressure-pump drive gear.

75. Assembly of Input Pressure Pump

Install the idler-gear shaft in the pump base, aligning the slot in the shaft with the pin in the base. Install the drive gear and idler gear in the base. Install the cover on the housing. Install the housing and cover assembly on the base (fig. 362). Install four $\frac{1}{8}$ -inch bolts and washers and torque the bolts 17 to 20 pound-feet.

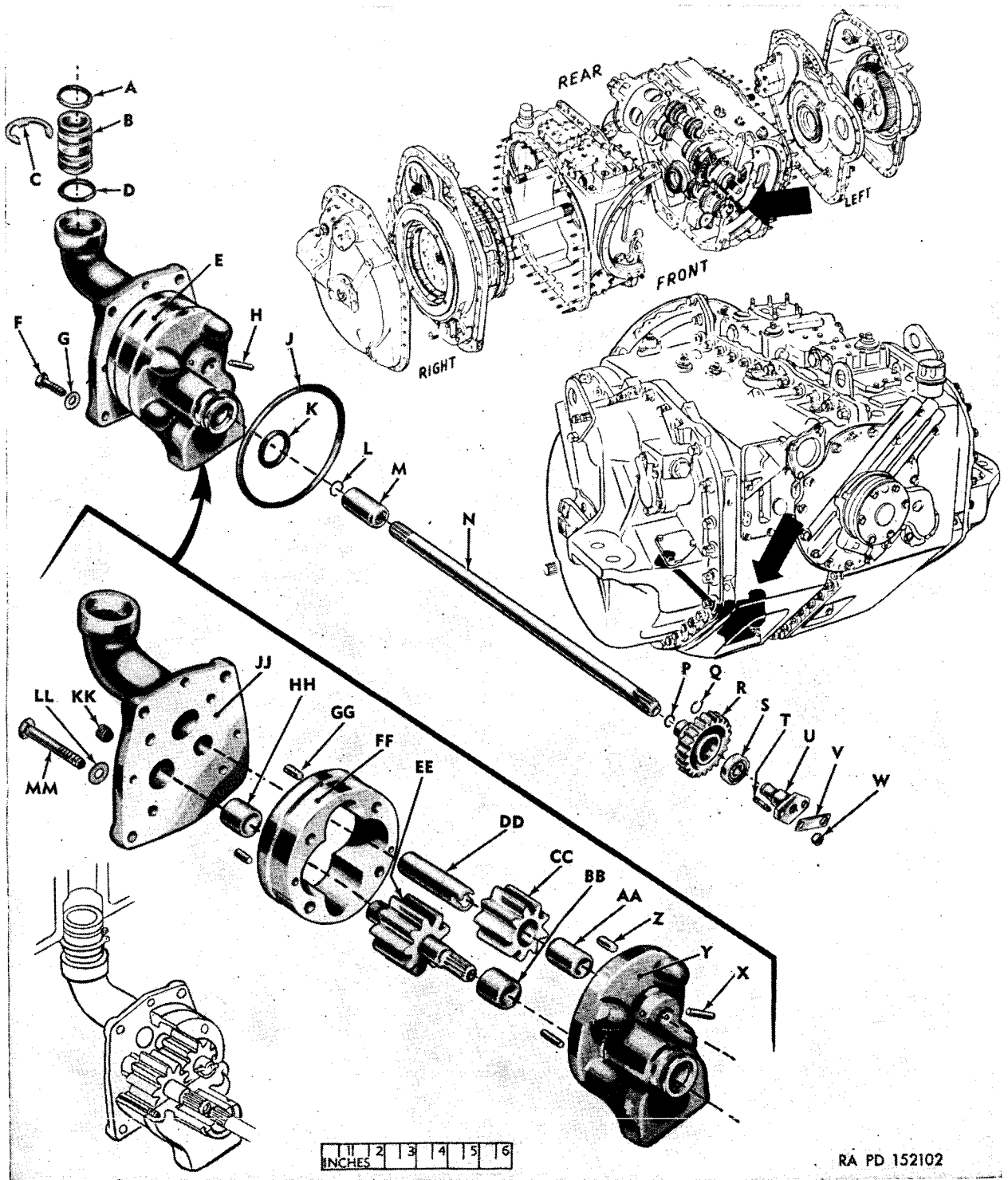


Figure 363. Input pressure pump assembly—exploded view.

A—"O" RING GASKET GM-6762127
 B—JUMPER TUBE GM-6764014
 C—SNAP RING GM-6764013
 D—"O" RING GASKET GM-6762127
 E—INPUT PRESSURE PUMP ASSEMBLY GM-6763994
 F—BOLT (4) GM-221584
 G—WASHER (4) GM-103340
 H—PIN GM-103695
 J—"O" RING GASKET GM-6703113
 K—"O" RING GASKET GM-6760723
 L—SNAP RING GM-6764531
 M—COUPLING GM-6764533
 N—DRIVE SHAFT GM-6764018
 P—SNAP RING GM-6764531
 Q—SNAP RING GM-6764019
 R—DRIVE GEAR GM-6764031
 S—BEARING GM-905202
 T—STUD (2) GM-6760364
 U—SPINDLE GM-6764050
 V—PLATE GM-6760159
 W—NUT (2) GM-103025
 X—PIN GM-103695
 Y—BASE GM-6764028
 Z—DOWEL (2) GM-141151
 AA—BUSHING GM-6704194
 BB—BUSHING GM-6704193
 CC—IDLER GEAR GM-6704492
 DD—IDLER GEAR SHAFT GM-6764012
 EE—INTERNAL DRIVE GEAR GM-6764011
 FF—HOUSING GM-6764010
 GG—DOWEL (2) GM-141151
 HH—BUSHING GM-6704193
 JJ—COVER GM-6764005
 KK—PLUG GM-103883
 LL—WASHER (4) GM-103340
 MM—BOLT (4) GM-221592

Figure 363—Continued.

Section XVI. REBUILD OF OUTPUT BRAKE AND PRESSURE PUMP

76. Disassembly of Output Brake and Pressure Pump

Remove the "O" ring gasket from the base of the output-brake- and pressure pump (fig. 364). Remove three screws from the pump base using a screwdriver and remove the base (fig. 365). Remove the internal drive gear and idler gear. Remove the idler-gear shaft being careful not to lose the shaft-locating ball. Remove the pump-gear housing (fig. 366). Remove the check-valve housing from the pump housing.

77. Cleaning

Refer to paragraph 25 for cleaning instructions.

78. Inspection and Repair

a. GENERAL. Refer to paragraph 26*a* through *l* for the general inspection and repair procedure. Refer to paragraph 107 for serviceability measurements and wear limits.

b. CHECK VALVES (fig. 367). Inspect the check valve assemblies for looseness in the housing or

base, improper valve action, and broken or worn parts. If any of the valve assemblies are defective, press or drive the defective assemblies out of the housing or the base. Install new valve assemblies with an arbor press.

c. BUSHINGS. If the bushings are defective, press or cut them out of their bores. Install new bushings with an arbor press. Ream the bushings to the correct size (par. 107).

79. Assembly of Output Brake and Pressure Pump

Install the check-valve housing on the pump housing (fig. 368). Install the idler gear shaft and locating ball in the check-valve housing (fig. 369). Install the gear housing on the check-valve housing (fig. 366). Install the pump-idler gear and internal drive gear in the pump-gear housing (fig. 370). Install the pump base on the pump-gear housing (fig. 365). Tighten the housings to the base with the three $\frac{5}{16}$ -inch screws. Install the three jumper tubes in the pump. Install one "O" ring gasket on the pump base.

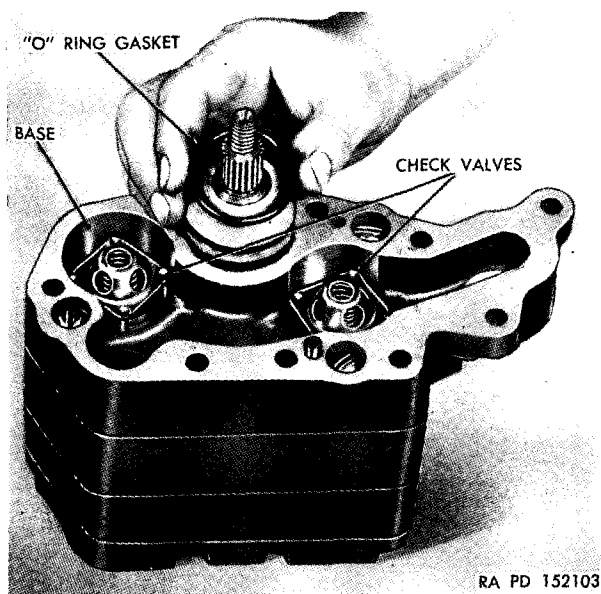


Figure 364. Removing or installing output-brake and pressure-pump "O" ring gasket.

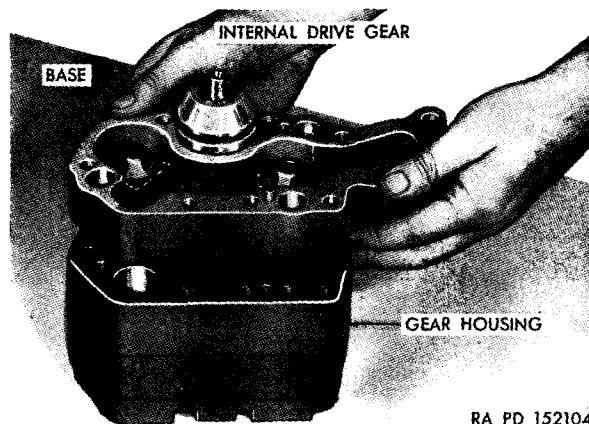


Figure 365. Removing or installing output-brake and pressure-pump base.

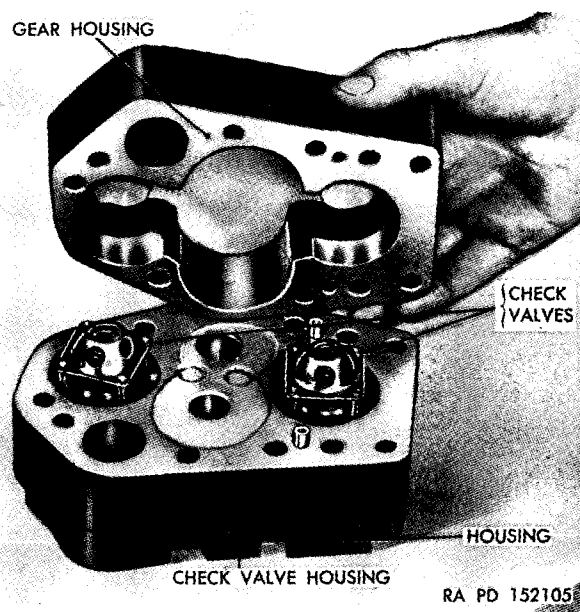


Figure 366. Removing or installing output-brake and pressure-pump gear housing.

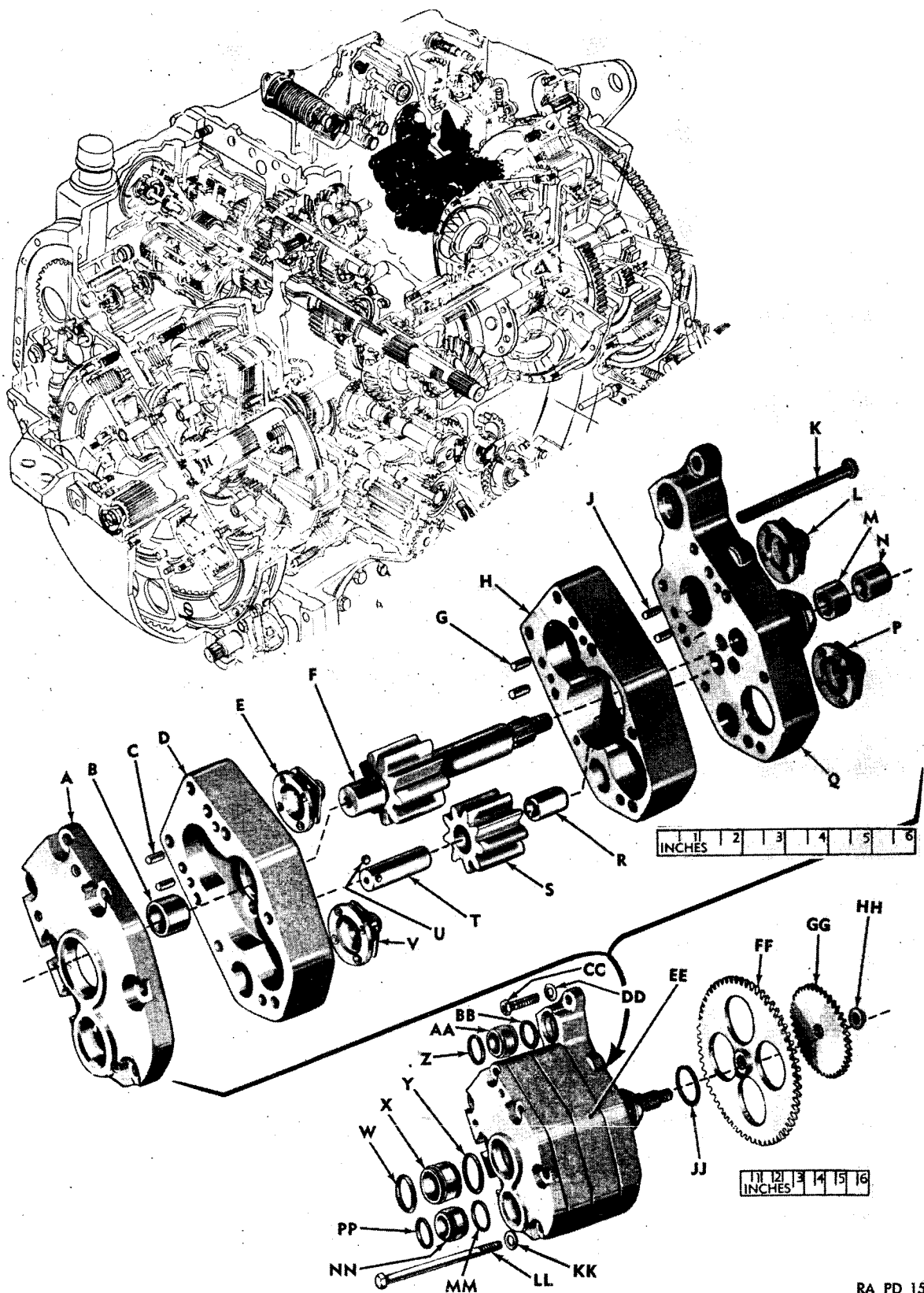


Figure 367. Output-brake and pressure-pump assembly—exploded view.

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A—PUMP HOUSING GM-6763806
 B—BUSHING GM-6765320
 C—DOWEL (2) GM-443767
 D—CHECK VALVE HOUSING GM-6765310
 E—CHECK VALVE GM-6763785
 F—INTERNAL DRIVE GEAR GM-6765306
 G—DOWEL (2) GM-443767
 H—GEAR HOUSING GM-6763840
 J—DOWEL (3) GM-443767
 K—SCREW (3) GM-140207
 L—CHECK VALVE GM-6763785
 M—BUSHING GM-6765320
 N—BUSHING GM-6765320
 P—CHECK VALVE GM-6763785
 Q—PUMP BASE GM-6765318
 R—BUSHING GM-6704194
 S—IDLER GEAR GM-6704492
 T—IDLER GEAR SHAFT GM-6760042
 U—SHAFT LOCATING BALL GM-147483
 V—CHECK VALVE GM-6763785

W—"O" RING GASKET GM-6760995
 X—JUMPER TUBE GM-6763945
 Y—"O" RING GASKET GM-6760995
 Z—"O" RING GASKET GM-6760478
 AA—JUMPER TUBE GM-6762497
 BB—"O" RING GASKET GM-6760478
 CC—BOLT (2) GM-221585
 DD—WASHER (2) GM-103340
 EE—OUTPUT BRAKE AND PRESSURE PUMP
 ASSEMBLY GM-6765316
 FF—PUMP DRIVE GEAR GM-6765308
 GG—GOVERNOR DRIVE GEAR GM-6765309
 HH—LOCK NUT GM-6763773
 JJ—"O" RING GASKET GM-6762223
 KK—WASHER (7) GM-103340
 LL—BOLT (7) GM-6763771
 MM—"O" RING GASKET GM-6760478
 NN—JUMPER TUBE GM-6762497
 PP—"O" RING GASKET GM-6760478

Figure 367—Continued.

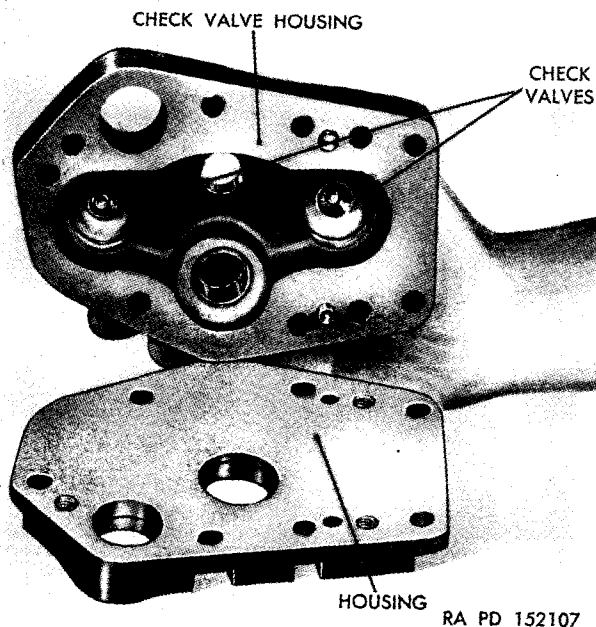


Figure 368. Installing output-brake and pressure-pump check-valve housing.

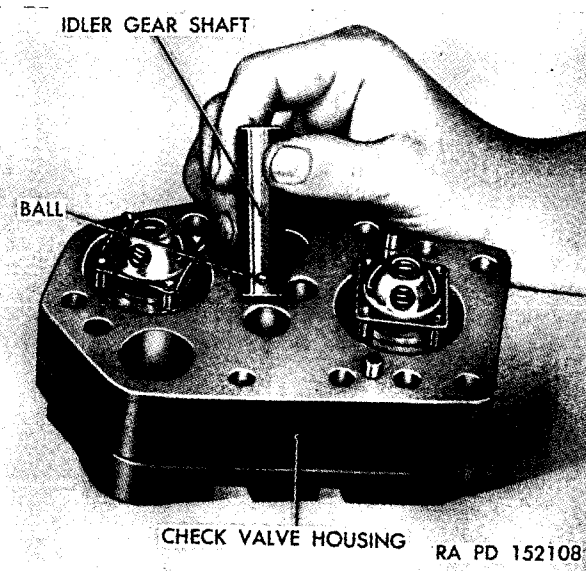


Figure 369. Installing output-brake and pressure-pump idler shaft.

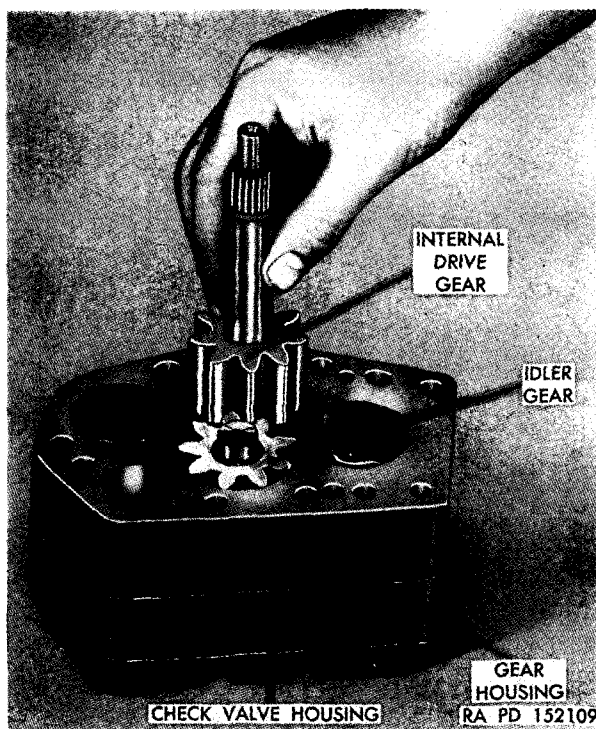


Figure 370. Installing output-brake and pressure-pump internal drive gear.

Section XVII. REBUILD OF OUTPUT SUMP PUMP

80. Disassembly of Output Sump Pump

Remove the jumper tube that has two "O" ring gaskets from the output-sump pump. Remove two screws from the pump with a screwdriver. Remove the base from the pump body (fig. 371). Remove the internal drive gear from the pump (fig. 372). Remove the idler gear. Using a soft hammer, separate the pump cover from the body. Remove the pump body (fig. 373).

81. Cleaning

Refer to paragraph 25 for cleaning instructions.

82. Inspection and Repair

a. GENERAL. Refer to paragraph 26a through l for the general inspection and repair procedure. Refer to paragraph 108 for serviceability measurements and wear limits.

b. CHECK VALVE ASSEMBLIES (fig. 374). Do not remove the check valve assemblies from the output-sump-pump cover or body unless they are defective. If the assemblies must be removed, drive them out with a drift. Press the new assemblies in place with an arbor press.

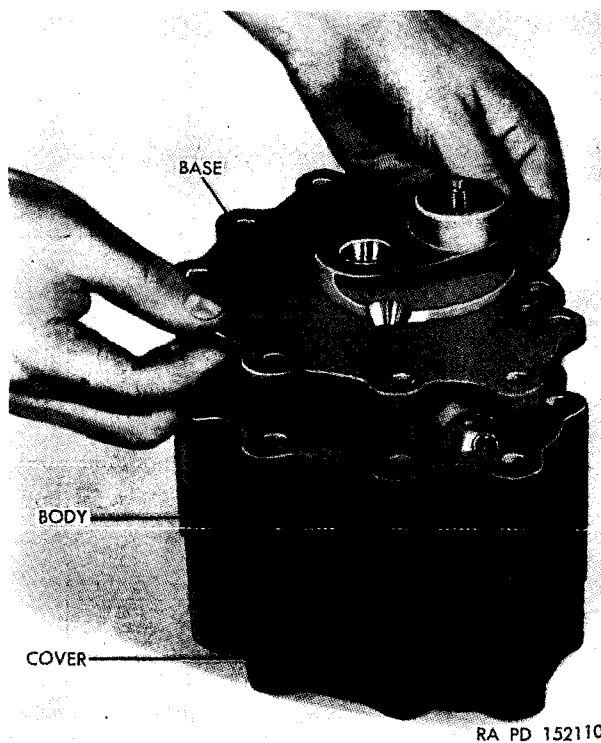


Figure 371. Removing or installing output-sump-pump base.

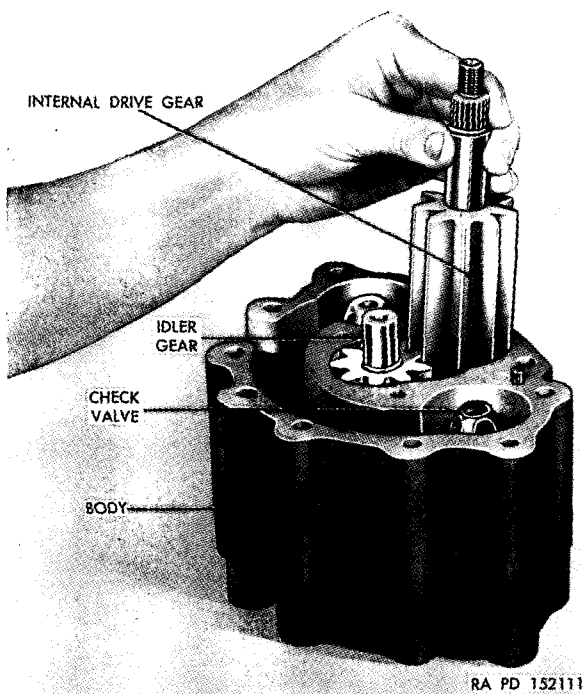


Figure 372. Removing or installing output-sump-pump-internal drive gear.

c. BUSHINGS. Do not remove the bushings in the cover and the base unless they are defective. One of the bushings in the cover and one in the base can be pressed out; the others must be cut out. Press in the new bushings and bore them to the correct size (par. 108). Be careful not to damage the split lines when driving out the bushings.

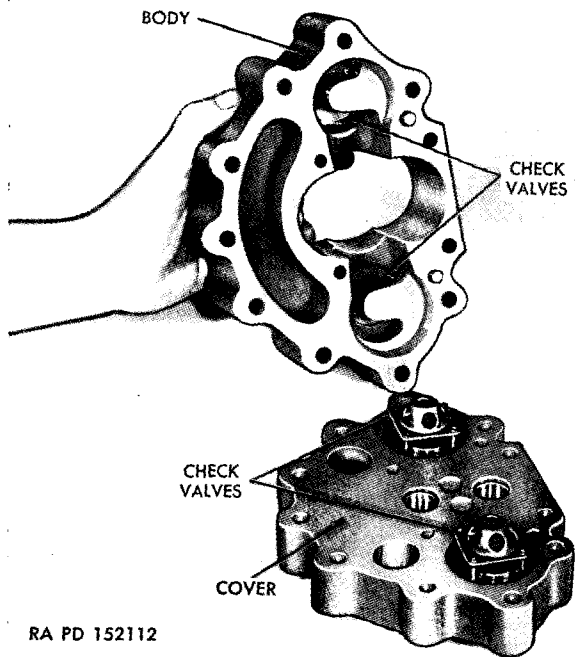
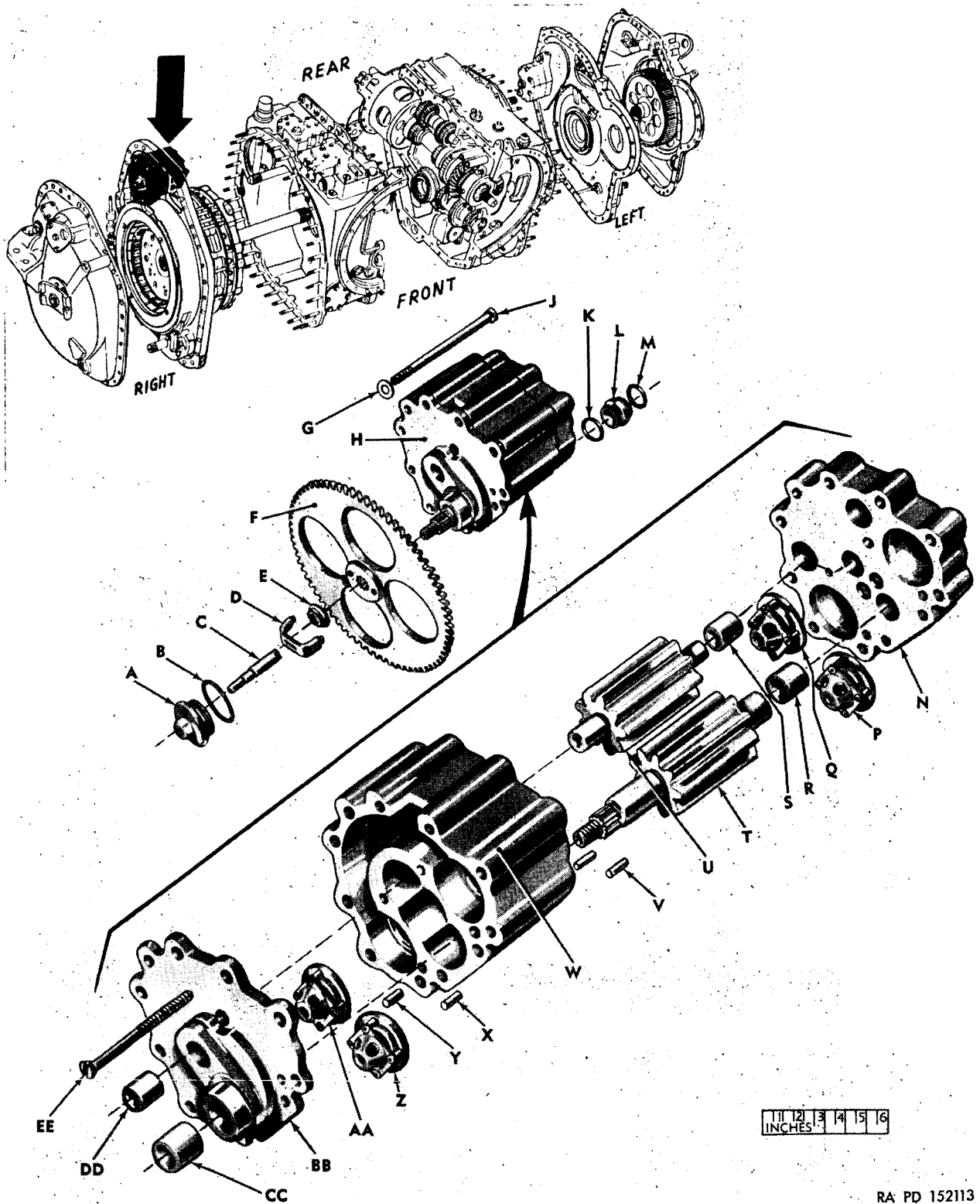


Figure 373. Removing or installing output-sump-pump body.

83. Assembly of Output Sump Pump

Install the body on the cover of the output sump pump, being careful to position the body properly on the dowel pins (fig. 373). Install the idler gear. Install the internal drive gear with the long shaft up (fig. 372). Install the base on the pump body (fig. 371). Install the two $\frac{1}{4}$ -inch screws. Install the jumper tube with the two "O" ring gaskets.



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Figure 374. Output sump pump, drive gear, coupling, and shaft—exploded view.

A—PLUG GM-6700953
 B—GASKET GM-6700954
 C—SHAFT GM-6763837
 D—SPEEDOMETER DRIVE COUPLING GM-6763884
 E—NUT GM-6763773
 F—OUTPUT SUMP PUMP DRIVE GEAR GM-6765305
 G—WASHER (11) GM-103340
 H—OUTPUT SUMP PUMP GM-6765317
 J—BOLT (11) GM-6763771
 K—"O" RING GASKET GM-6760995
 L—JUMPER TUBE GM-6763945
 M—"O" RING GASKET GM-6760995
 N—COVER GM-6765312
 P—CHECK VALVE ASSEMBLY GM-6763785
 Q—CHECK VALVE ASSEMBLY GM-6763785
 R—BUSHING GM-6765320
 S—BUSHING GM-6704193
 T—INTERNAL DRIVE GEAR GM-6765307
 U—IDLER GEAR GM-6765322
 V—DOWEL (2) GM-443767
 W—BODY GM-6763793
 X—DOWEL GM-443767
 Y—DOWEL GM-141197
 Z—CHECK VALVE ASSEMBLY GM-6763785
 AA—CHECK VALVE ASSEMBLY GM-6763785
 BB—BASE GM-6765311
 CC—BUSHING GM-6765321
 DD—BUSHING GM-6704193
 EE—SCREW (2) GM-119901

Figure 374—Continued.

Section XVIII. REBUILD OF STEERING OVERSPEED LIMIT PUMP

84. Disassembly of Steering Overspeed Limit Pump

Using a $\frac{3}{16}$ -inch hex wrench, remove two bolts from the steering-overspeed-limit pump (fig. 375). Remove the body from the head of the limit pump (fig. 376). Remove the rotor from the head of the pump (fig. 377).

85. Cleaning

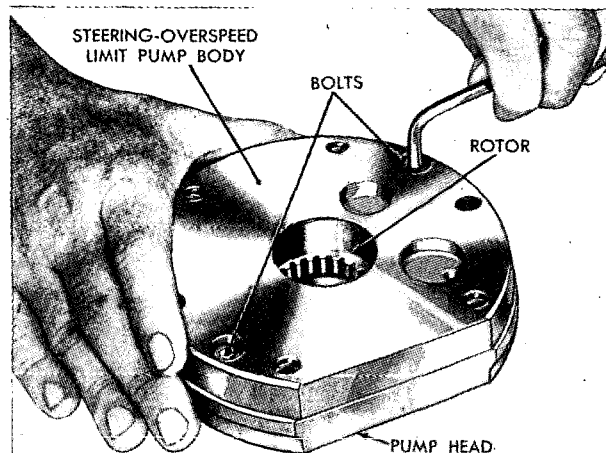
Refer to paragraph 25 for cleaning instructions.

86. Inspection and Repair

Refer to paragraph 26a through l for the general inspection and repair procedure. Refer to paragraph 109 for serviceability measurements and wear limits. Refer to figure 378.

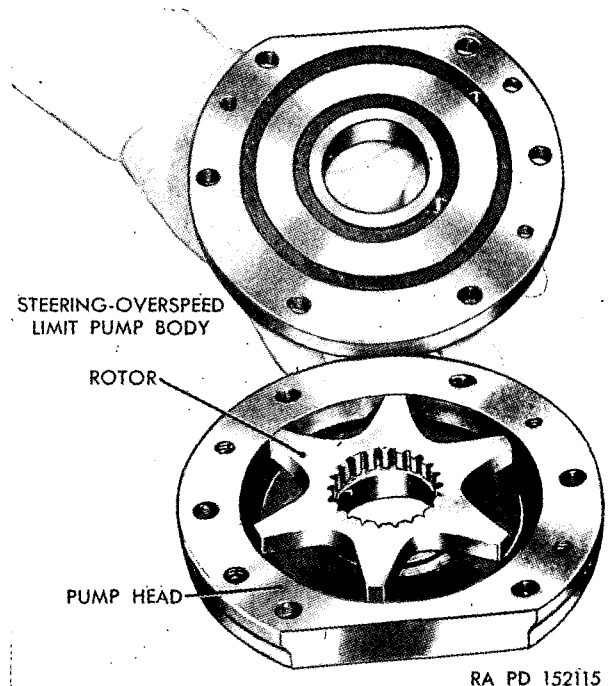
87. Assembly of Steering Overspeed Limit Pump

Install the rotor in the head of the steering-overspeed-limit pump. Install the body on the head, aligning the holes properly. Secure the body to the head with two $\frac{1}{4}$ -inch bolts.



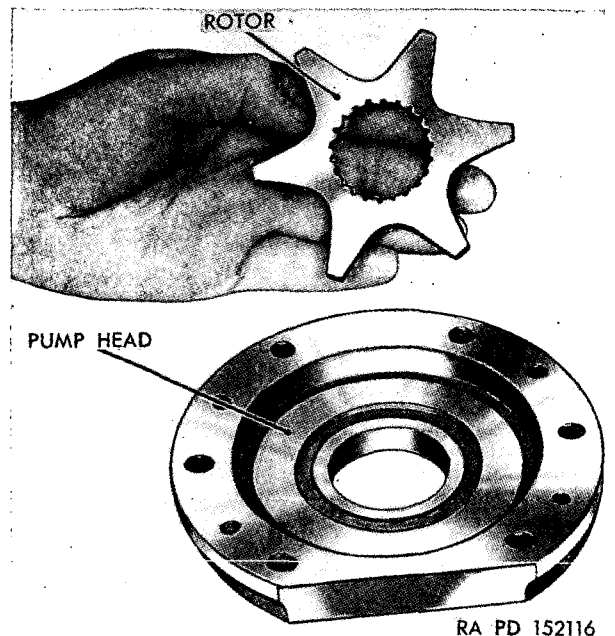
RA PD 152114

Figure 375. Removing or installing steering-overspeed-limit-pump bolts.



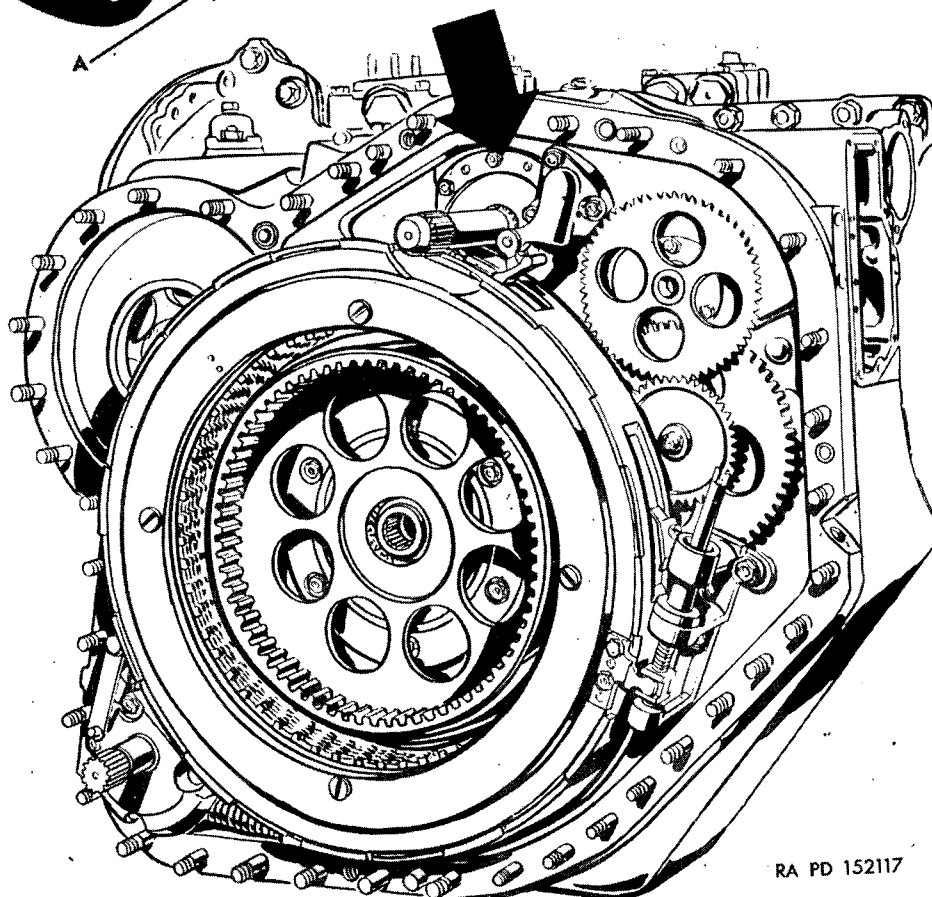
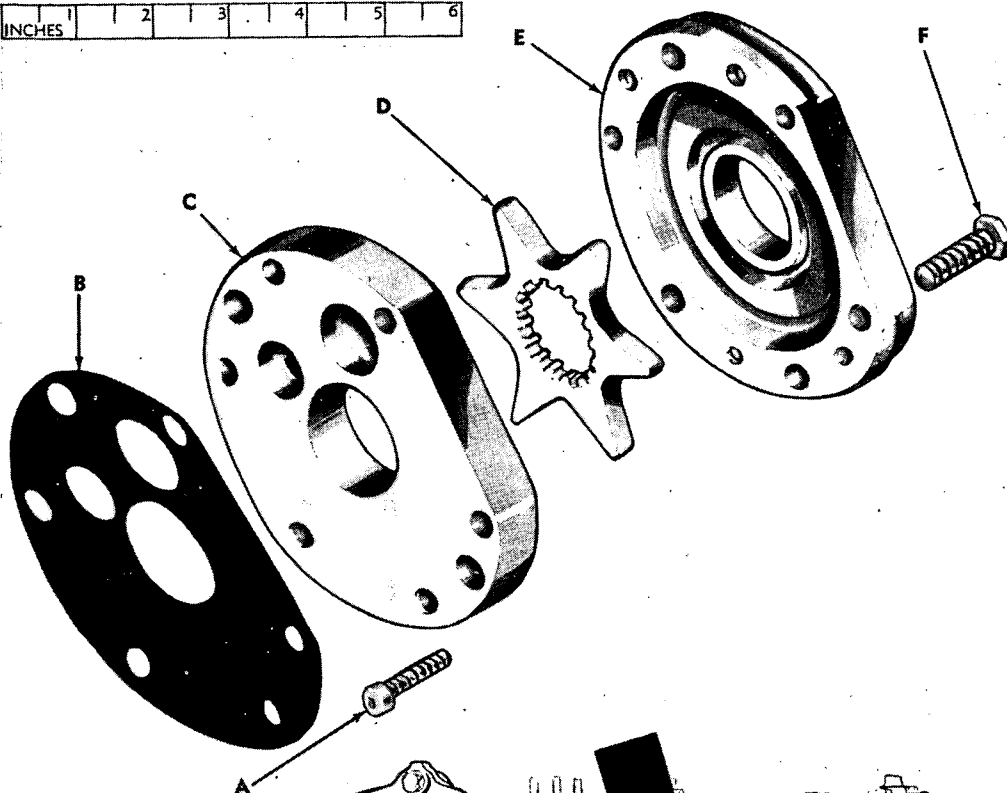
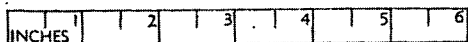
RA PD 152115

Figure 376. Removing or installing steering-overspeed-limit-pump body.



RA PD 152116

Figure 377. Removing or installing steering-overspeed-limit-pump rotor.



RA PD 152117

A—BOLT (2) GM-138202
B—GASKET GM-6765455

C—PUMP BODY GM-6765408
D—ROTOR GM-6765410

E—PUMP HEAD GM-6765409
F—BOLT (6) GM-221587

Figure 378. Steering-overspeed-limit pump assembly—exploded view.

Section XIX. ASSEMBLY OF TRANSMISSION FROM SUBASSEMBLIES

88. Preliminary Instructions

a. **EQUIPMENT.** Use the same equipment for the assembly of the transmission from subassemblies that was used during the disassembly of the transmission. Refer to paragraph 22a.

b. **CLEANING.** Be sure that all the subassemblies are properly cleaned before they are assembled to the transmission (par. 25). All thrust surfaces, gears, splines, bushings and bearings must be oiled as they are installed. To make sure that no cotter pins, jam nuts, or lock wire will be omitted, install these safety devices immediately after installing the parts which must be secured.

89. Assembly of Transmission from Subassemblies

a. **INSTALLATION OF RIGHT HOUSING ON LEFT HOUSING.**

- (1) Inspect both housings for damage to the housing-to-housing split lines and split line studs. Make sure that there are three "O" ring gaskets on the left housing-to-right housing split line and four on the right housing-to-left-housing split line.
- (2) Spread a thin coat of sealing compound on the housing-to-housing split line and wipe away the excess. Oil the gears in the left housing. Attach the lifting sling (C7083778) to the end-plate split line of the right housing and lift the housing with a hoist. Position the right housing over the left housing, making sure the right housing is level (fig. 105).
- (3) Lower the right housing until the left and right housings are close together and the right housing studs have entered the left housing-stud holes. Turn the right steering cross shaft enough to mesh the right steering gear with the steering-differential bevel pinions. Then lower the right housing until the lifting sling no longer supports the housing. Install one bolt, nut, and two washers through the split line at each corner of the housing.
- (4) Bring the split lines together by tightening evenly at the four corners.

Caution: Do not tighten one side first and then the other.

- (5) Install thirty-two $\frac{1}{2}$ -inch nuts, thirty-two jam nuts, thirteen $\frac{1}{2}$ -inch bolts, and forty-five washers on the split lines to secure them. Install the transmission lifting eye on the right side of the top split line so that the second and third bolts from the rear will secure the eye to the right housing.

- (6) Install a lock plate and two $\frac{5}{16}$ -inch nuts on the pump- and fan-drive-pinion shaft. Tighten all four of the nuts and bend up the corners of the lock plate to lock the nuts in place (fig. 103). Install two $\frac{3}{8}$ -inch bolts, washers, and castellated nuts, through the split line in the fly-wheel housing (fig. 102). Secure the nuts with cotter pins.

b. **INSTALLATION OF CONTROL VALVE BODIES.**

- (1) Install the steering-valve-body plate and the gasket on the right housing, securing the plate with five $\frac{5}{16}$ -inch bolts (fig. 101). Torque the bolts 17 to 20 pound-feet.
- (2) Install the steering-control valve body and the gasket on the valve body plate, securing the valve body with ten $\frac{5}{16}$ -inch bolts (fig. 100). Torque the bolts 17 to 20 pound-feet.

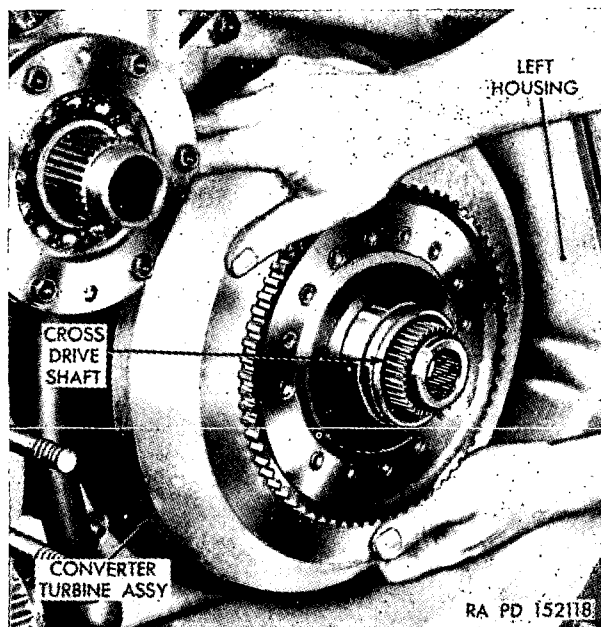


Figure 379. Rotating converter output shaft using converter turbine.

- (3) Install the range-control valve body and the gasket on the right housing (fig. 99). Secure the valve body to the housing with thirteen $\frac{3}{8}$ -inch bolts and washers. Torque the bolts 33 to 40 pound-feet.

c. INSTALLATION OF RIGHT END PLATE.

- (1) Remove the lifting sling (C7083778) and attach two strands of the sling to two studs near the top center of the right housing-to-end-plate split line. Hoist the transmission (fig. 97). Lower the transmission so that its left bottom rests on a 2 x 4 wooden block. Then lower the transmission and rest the right bottom on a 2 x 4 block. If it is necessary level the transmission. Make sure the three "O" ring gaskets are installed on the right housing split line.
- (2) Apply sealing compound to the left split line of the right end plate. Attach the

lifting sling (41-S-3830-550) to the right end plate and hoist to the proper level for installation (fig. 96). Make sure the jumper tube for the output sump pump is properly installed in the right housing. Be sure the two "O" ring gaskets are on the jumper tube.

- (3) Install the right end plate and drive-clutch package unit assembly in the right housing. Rotate the converter-output shaft slowly to engage the splines of the high-range-clutch housing.

Note. Rotate the shaft by rotating the converter turbine assembly (fig. 379), causing it to spline with the converter-output shaft.

Draw the end plate into place evenly, using washers and nuts on four studs (fig. 380).

- (4) If the package unit has been rebuilt (pars. 48 through 51), apply 33- to 40-

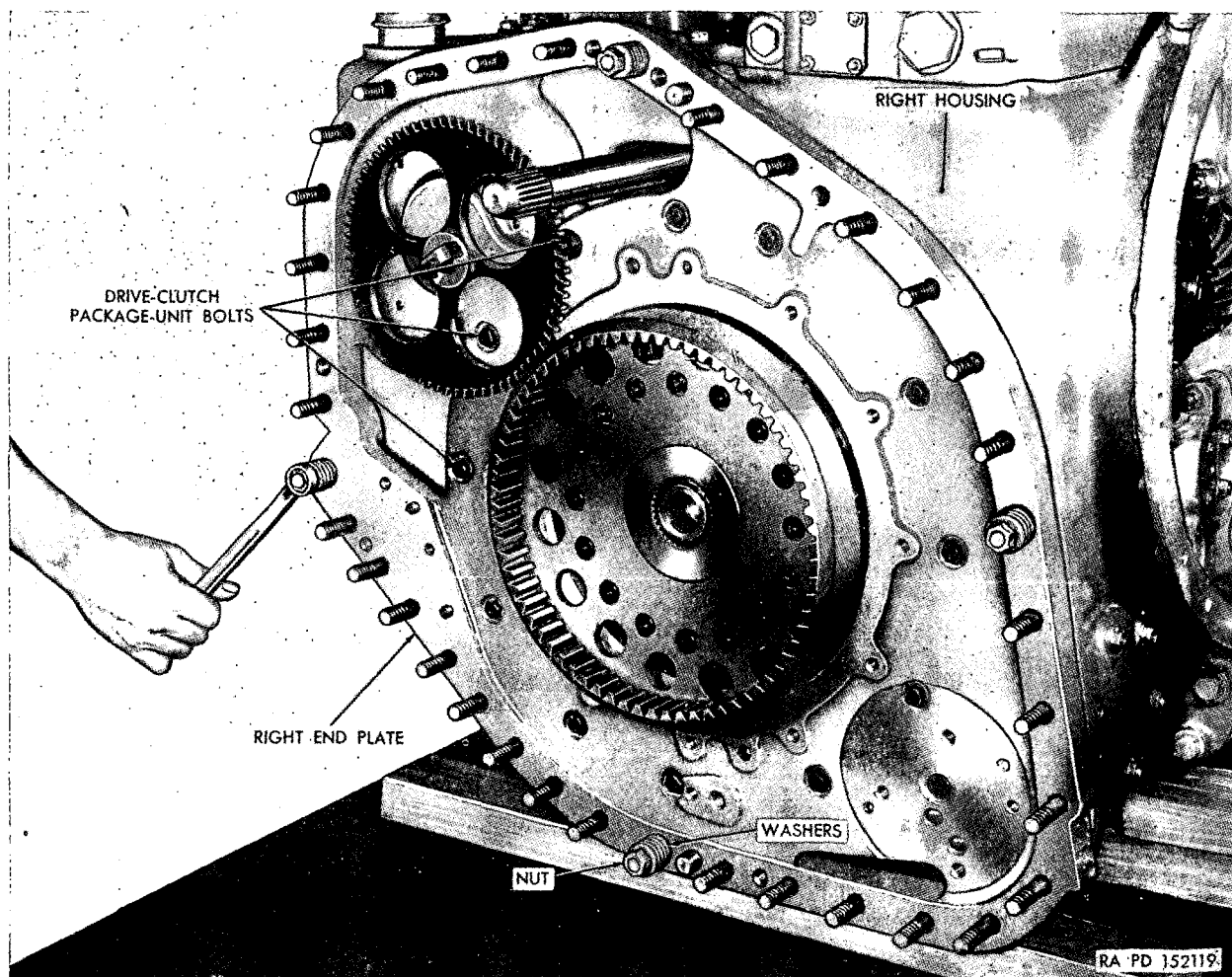


Figure 380. Installing right end plate.

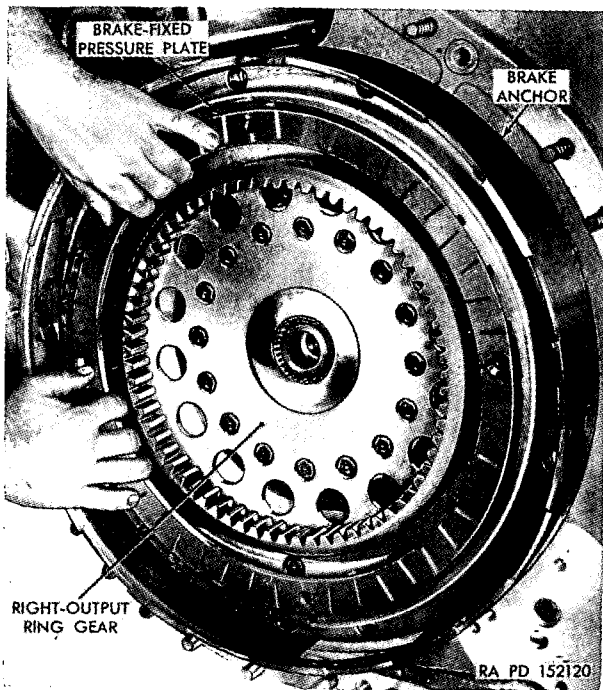


Figure 381. Installing brake-fixed-pressure plate.

pound-feet torque to the 12 bolts which hold the package unit together. Check to see that the converter-output shaft can be rotated.

Note. If the converter-output shaft cannot be rotated, remove the end plate and find the cause before proceeding with the assembly of the transmission.

Remove the nuts and washers which were used to draw the right end plate and package unit assembly into place.

- (5) Install the right brake anchor in the end plate so that the recess provided for the output-sump-pump drive gear is in its proper position (fig. 94). Secure the brake anchor with ten $\frac{3}{8}$ -inch, self-locking bolts installed in the inner bolt circle. Install one $\frac{3}{8}$ -inch, self-locking bolt on the bottom of the outer circle (fig. 93). Torque the bolts 33 to 40 pound-feet.
- (6) Install the brake-fixed-pressure plate on the two dowels on the brake anchor (fig. 381). Secure the pressure plate to the anchor with two screws (fig. 92). Stake the screw heads at each end of the slot. Install 10 brake-plate release springs in the outer circle of the brake anchor (fig. 382).
- (7) Install the brake disk pack, starting

with an internally-splined steel disk. Then install alternately a bronze externally-splined disk and a steel disk, until five bronze and six steel disks have been installed (fig. 91).

Note. All steel disks must be installed with the cone toward the outside of the transmission.

- (8) With the retainer (C7083772) in place, install the brake-apply-cam-rotating ring, the brake-apply-cam-stationary ring, the brake-apply ring and the brake-floating-pressure plate assembly in the brake anchor (fig. 90). Press against the brake-apply-cam-stationary ring and rotate the brake-apply ring until the tabs on the floating-pressure plate line up with the grooves on the brake anchor.
- (9) Press against the brake-apply-cam-stationary ring until its tabs line up with the grooves in the brake anchor. Using a drift and hammer on the brake-apply-cam-stationary ring, rotate the ring until the cam-bracket mounting holes in it are alined with the cam-bracket openings in the brake anchor (fig. 89).
- (10) Install the brake-apply-cam bracket on the brake-apply-cam-rotating ring (fig.

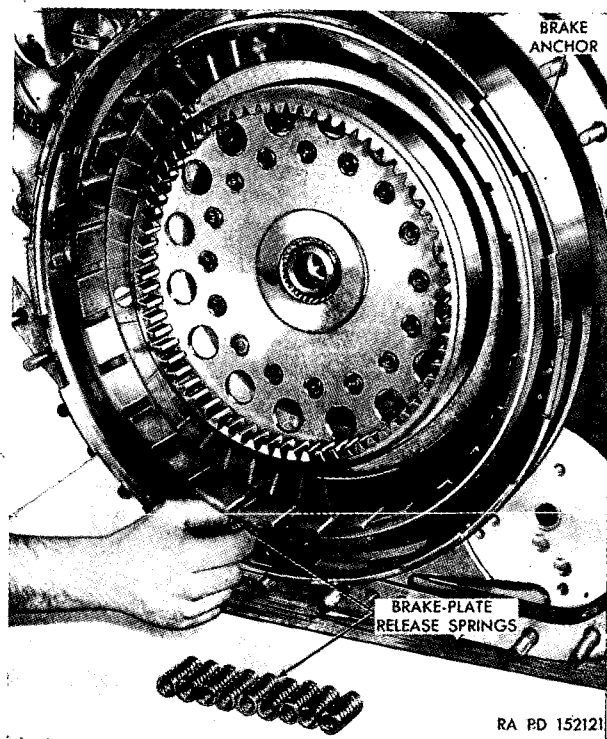


Figure 382. Installing brake-plate release springs.

88). Secure the bracket to the ring with two $\frac{5}{16}$ -inch bolts torqued 17 to 20 pound-feet. Install the brake-shaft inner bracket on the right end plate with the bearing side out. Install the brake-apply shaft bracket on the two dowel pins on the inner bracket (fig. 383). Secure the brake-apply shaft bracket to the end plate with four $\frac{5}{16}$ -inch bolts torqued 33 to 40 pound-feet.

- (11) Install the brake-lubrication valve and brake-return-cam bracket assembly (fig. 384). Secure it to the brake-apply-cam-rotating ring with one $\frac{5}{16}$ -inch bolt torqued 17 to 20 pound-feet. Using a screwdriver, install the brake-return-cam spring between the brake-shaft bracket and brake-return cam bracket (fig. 85).
- (12) Install the brake-apply strut between the brake-apply-cam bracket and the brake-apply lever, using a screwdriver (fig. 84). Install the brake-apply-strut retainer over the pin in the brake-apply-shaft lever.
- (13) Place the spacer under the strut retainer and secure the retainer to the brake-apply-cam bracket with the special shoulder-type bolt and the wave washer. Secure the strut-retainer bolt with lock wire (fig. 83). Remove the retainer (C7083772) from the brake-apply ring assembly.

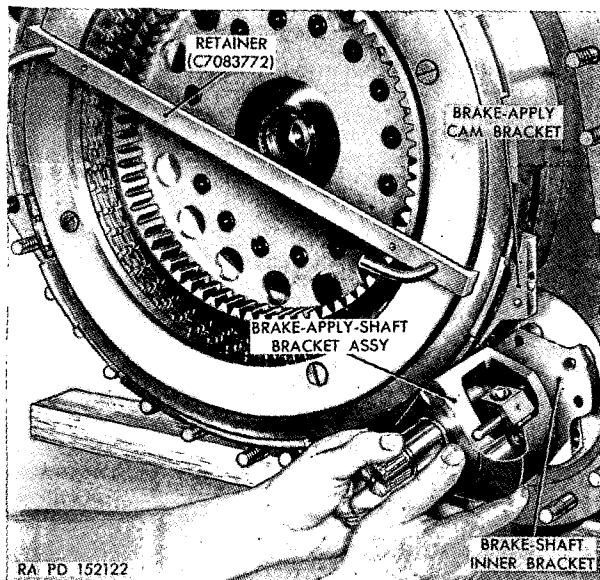


Figure 383. Installing brake-apply shaft bracket.

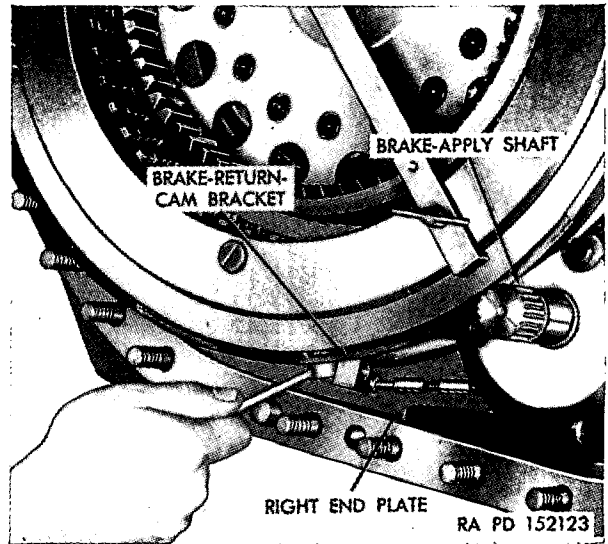


Figure 384. Installing brake-return-cam bracket assembly.

- (14) Place the brake-adjustment bracket on the brake-adjusting-bracket follower and install the assembly on the end plate dowel pins (fig. 82). Secure the assembly to the end plate with two $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 33 to 40 pound-feet.
- (15) Secure the brake-adjustment bracket to the brake-apply-cam-stationary ring with two $\frac{5}{16}$ -inch self-locking bolts torqued 17 to 20 pound-feet.
- (16) Make sure the thrust washer is in place on the internal side of the right output planet carrier assembly. Install the assembly into the brake disks, pushing and rotating the carrier assembly until it is in all the way (fig. 385).
- (17) Check the installation by turning the output shaft to see that it causes the output-sump-pump drive gear to rotate. Install the thimble (41-T-1640) on the brake-apply shaft (fig. 386).

d. INSTALLATION OF RIGHT END COVER.

- (1) Apply sealing compound to the split line of the right end cover. Attach the hoist to the lifting eye of the right end cover. Lift the end cover and position it near the right end plate for installation. Make sure the thimble is installed on the brake-apply shaft (fig. 386).
- (2) Install the right end cover onto the brake-apply shaft and split line studs,

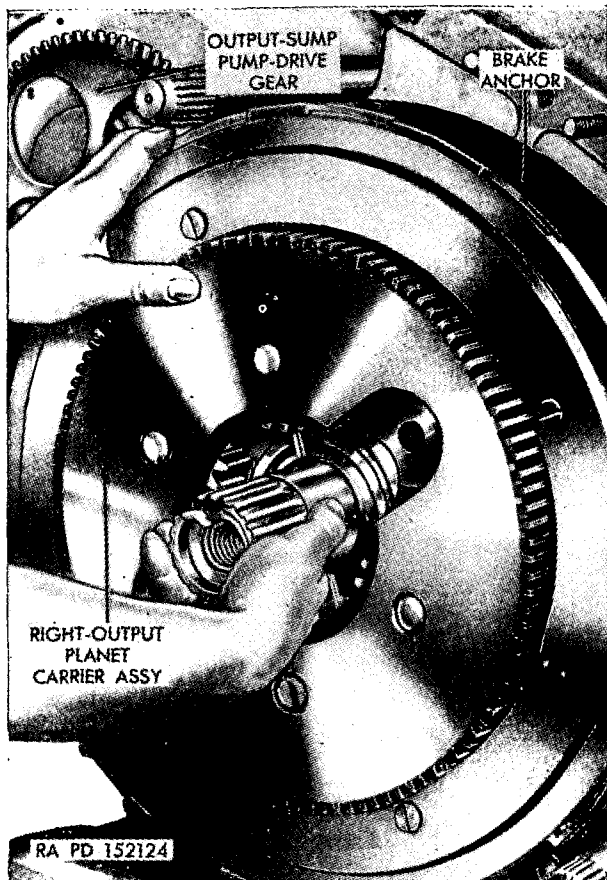


Figure 385. Installing right output planet carrier assembly.

rotating the steering shafts in the rear of the transmission to engage the splines of the right steering cross shaft with the steering-output pinion.

Note. If the right end cover is being installed with the steering clutch assembly in the transmission, rotate the left steering cross shaft. If the left end cover is installed, the steering-differential inspection plate on top of the transmission must be removed and a screwdriver used to turn the gear.

- (3) Use a soft hammer to tap the end cover into place. Remove the thimble from the brake-apply shaft. Install the gasket and brake-adjustment cover on the end plate (fig. 79). Secure the cover with three $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet.
- (4) Install 36 washers, $\frac{1}{2}$ -inch nuts, and jam nuts on the right housing studs to secure the right end cover to the transmission. Torque the nuts 42 to 50 pound-feet.
- (5) Apply heavy grease to the right output shaft so that the output flange will go on more easily. Install the flange, lining up the grooves on the external face of the flange with the slots on the output shaft (fig. 387).

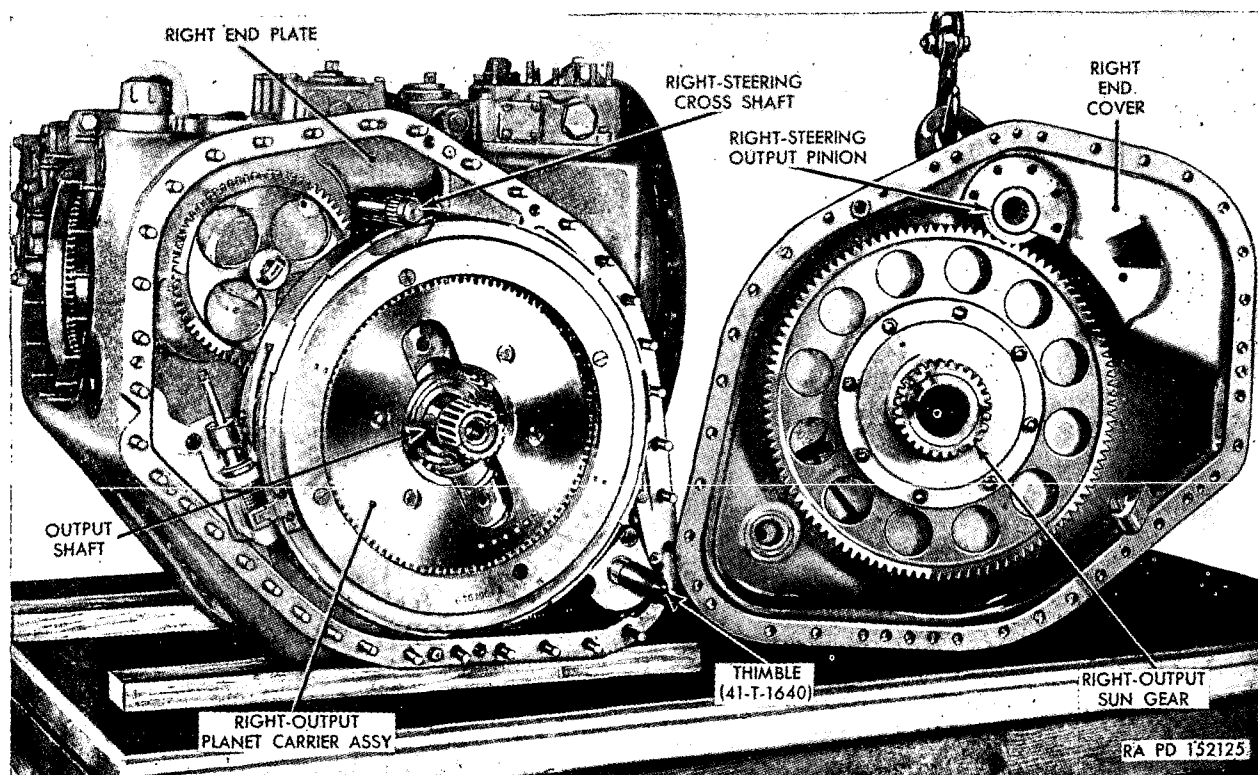


Figure 386. Oil-seal thimble installed on right brake-apply shaft.

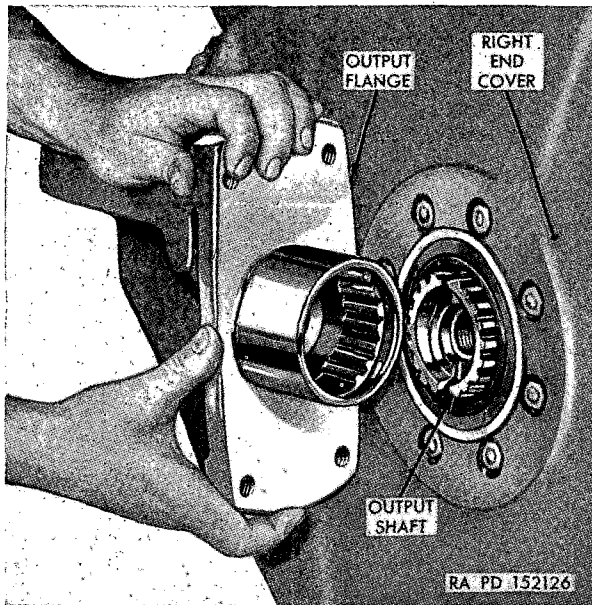


Figure 387. Installing output flange.

- (6) Install the output-flange lock screw and the copper gasket. Torque the lock screw 150 to 200 pound-feet. Install lock wire to secure the screw. Install the brake-apply arm and the snap ring on the brake-apply shaft.

e. INSTALLATION OF TORQUE CONVERTER.

- (1) Install eleven $\frac{3}{8}$ -inch nuts and washers in the converter cavity and reservoir well in the left housing. They secure the internal split line (fig. 388).

Note. Make sure all the nuts are installed. Also, make sure that one $\frac{3}{8}$ -inch bolt and washer are installed behind the output-brake and pressure-pump oil passage in the reservoir well.

Torque the nuts 17 to 20 pound-feet, torque the bolt 33 to 40 pound-feet. The 10 bolts which secure the gearing must be torqued 42 to 50 pound-feet.

- (2) Secure the converter ground sleeve bolts with locking wire as shown in figure 388. With the hook-type seal ring in place on the ground sleeve, install the converter seal assembly (fig. 78). Engage the three tangs in the slots on the ground sleeve.
- (3) Install the converter-pump-hub sleeve on the pump hub with the flange of the sleeve on the internal side of the pump. Install the pump and sleeve onto the converter ground sleeve assembly (fig. 389). Press

against the pump-hub sleeve and align its slot with the lock pin on the ground sleeve. Install the thrust washer on the ground sleeve.

- (4) With the stators assembled on the arbor (41-A-339-24), install the arbor in the converter ground sleeve (fig. 76). Hold the arbor firmly against the ground sleeve. Press in on the stator spacer rotating the stator pack in a counterclockwise direction until the stator pack is on the ground sleeve (fig. 75). Press in on the stator spacer and push the stator pack toward the pump as far as it will go. Remove the arbor.

Note. Check to see that both stators are free to rotate counterclockwise and that they are not free to rotate clockwise.

- (5) Install the thrust washer on the ground sleeve. Install the locking ball in the recess in the ground sleeve. Install the stator retainer over the locking ball with the bevel side out (fig. 73). Install the retainer snap ring on the ground sleeve (fig. 72). Make sure the snap ring is all the way down into the groove. Check the stator end play with a feeler gage (fig. 390). The end play must be within 0.009 to 0.040 inch.
- (6) Install the turbine and shaft assembly into the lock-up clutch housing, engaging the gear on the turbine with the splines in the lock-up clutch plate. Install the gasket on the converter pump.
- (7) Install the lock-up clutch, main plate, and converter turbine assembly on the pump, rotating the turbine slowly to engage its splines in the converter output shaft. Align the holes and the gasket. Install the twenty-four $\frac{5}{16}$ -inch bolts. Tighten them snugly. They will be torqued later.
- (8) Install the converter drive gear on the shaft-end of the input-driven bevel gear (fig. 69). Using wrench (B7083775) and holding plug (A7083776), install the spanner nut over the converter drive gear (fig. 67). Torque the nut to 300 pound-feet using torque wrench (41-W-3634) (fig. 68). Refer to note in paragraph 23g(1). If a pair of lock screw holes are not aligned, tighten the nut until

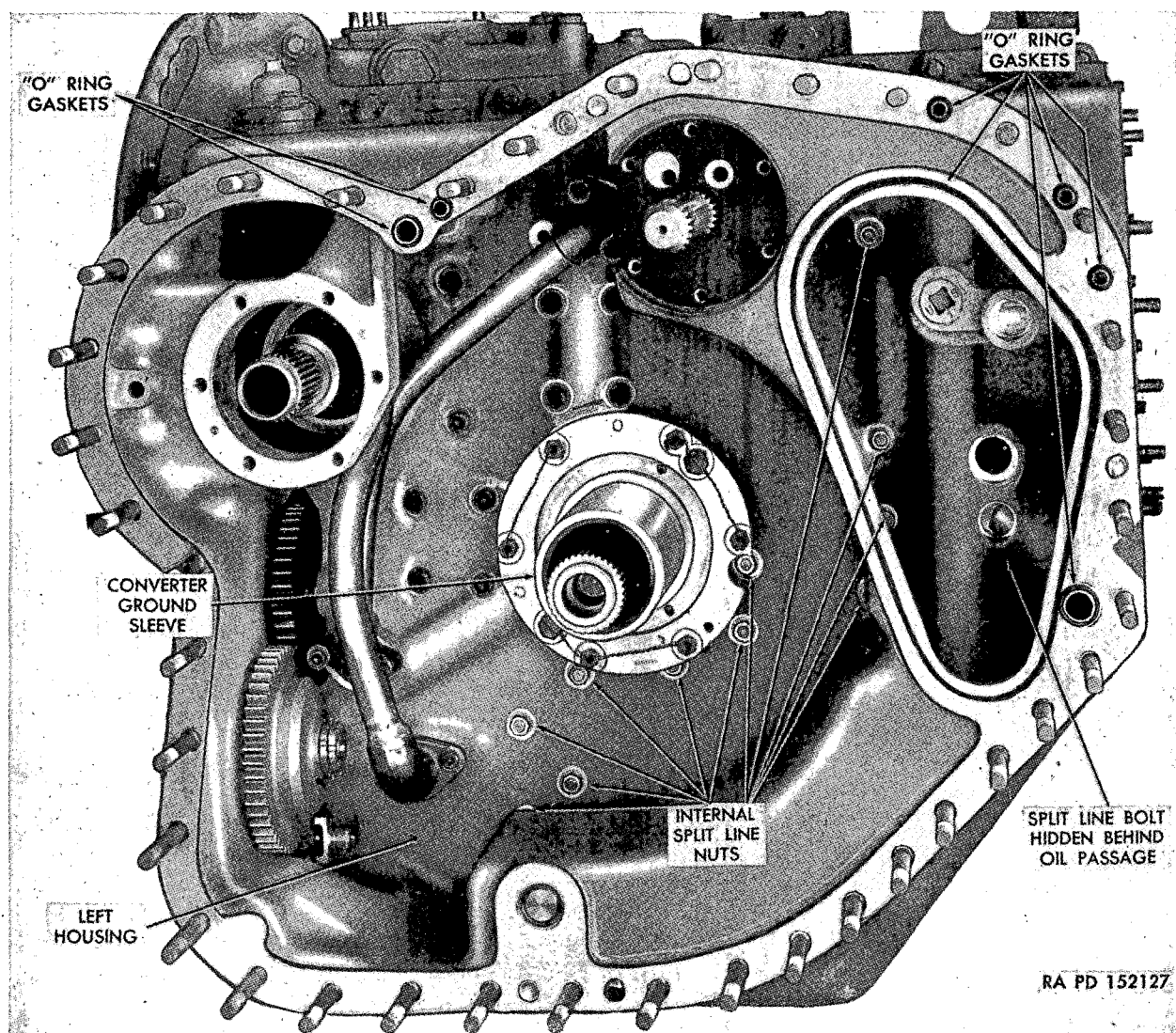


Figure 388. Converter cavity and reservoir well in left housing.

a pair are alined. Using a $\frac{3}{32}$ -inch hex wrench, lock the spanner nut with a set-screw (fig. 66). Stake metal over the screw.

- (9) Install the steering-overspeed-limit pump and gasket. Secure the pump with six $\frac{5}{16}$ -inch bolts (fig. 391).

f. INSTALLATION OF LEFT END PLATE.

- (1) Check to see that seven "O" ring gaskets are in place on the left housing split line. Apply sealing compound to the right split line of the left end plate. Attach the lifting sling (41-S-3830-550) to the left end plate. Pack grease around the two hook-type seal rings in the lock-up clutch housing and center them in their grooves.

- (2) Install the left end plate (fig. 392), rotating the input gearing to allow the entry of the hook-type seal rings into the end plate bore. After drawing up the left end plate flush-tight with the nuts and washers, remove them.

Note. At this time, apply 17 to 20 pound-feet torque to the twenty-four $\frac{5}{16}$ -inch bolts that hold the converter assembly together. Torque them through the opening in the left end plate.

- (3) Check the turbine end play by using a hammer and a soft drift to tap the converter assembly back as far as it will go. Insert the drift through holes in the end plate and be sure to tap the converter assembly back evenly. Then

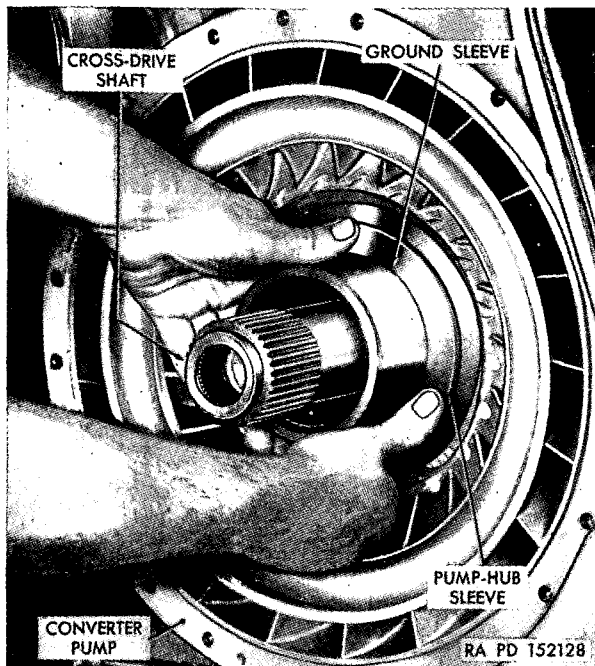


Figure 389. Installing converter pump assembly.

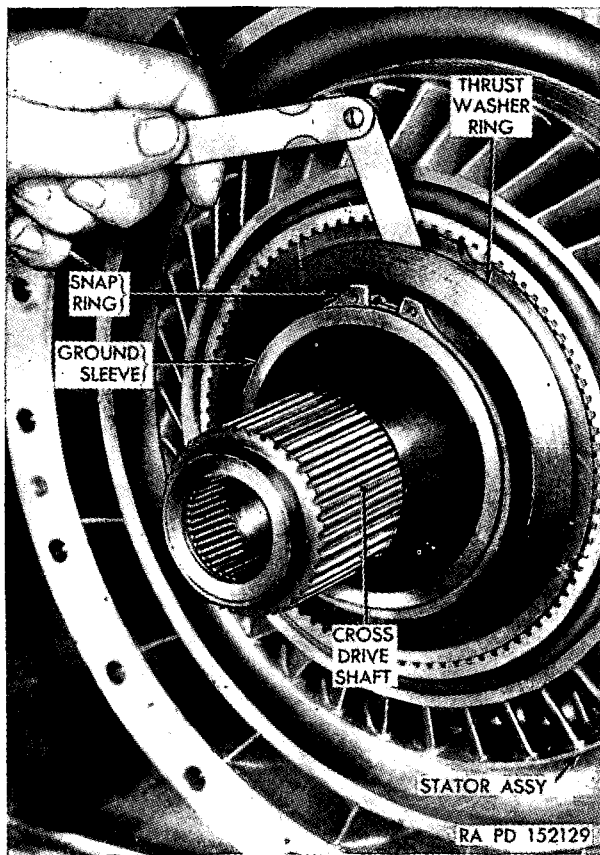


Figure 390. Checking converter stator end play.

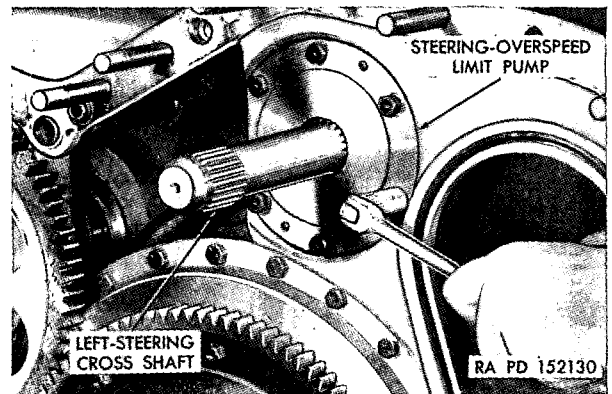


Figure 391. Installing steering-overspeed-limit-pump bolts.

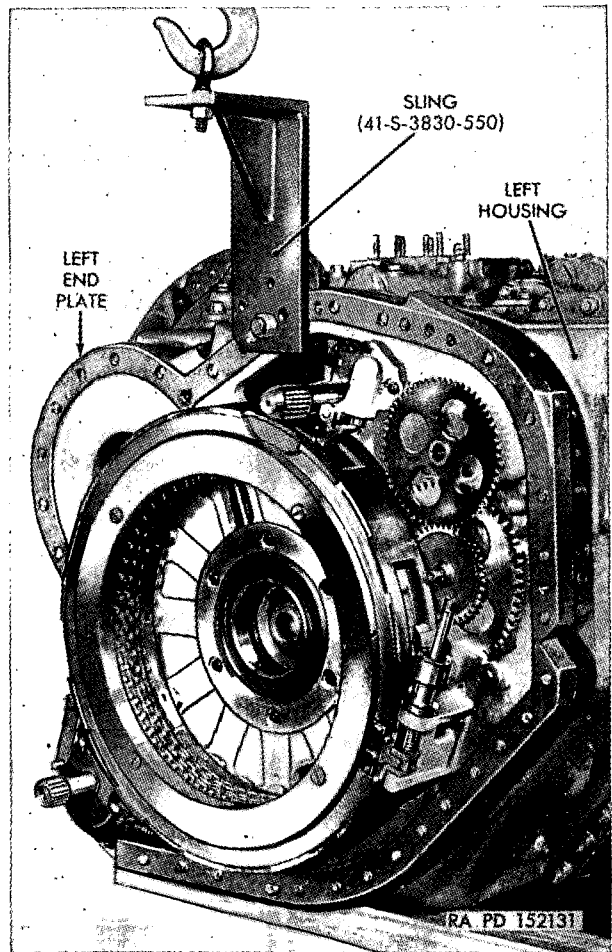


Figure 392. Installing left end plate.

take a measurement, using a depth micrometer, from a smooth surface on the end plate to a smooth surface on the converter-pump drive gear. Record this measurement.

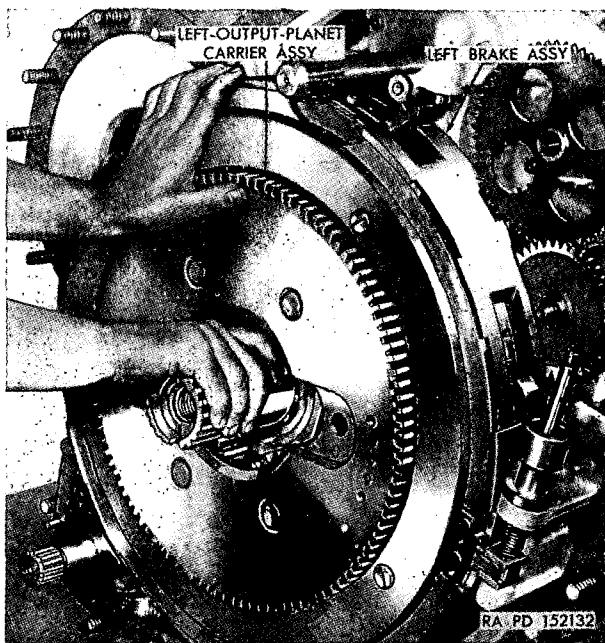


Figure 393. Installing left output planet carrier.

- (4) Through an opening in the front of the transmission, pry the converter assembly against the left end plate. Take another measurement in the same place as the first. The difference in the two measure-

ments is the turbine end play which should be within 0.005 to 0.040 inch. If the end play is not within the allowable tolerance, remove the left end plate and check for the cause.

- (5) Install the shims on the end of the cross-drive shaft (fig. 63). Install the left output ring gear (fig. 62). With the thrust washer in place, install the left output planet carrier. Rotate the planet carrier to engage the brake plates and the oil pump gear (fig. 393). Install the thimble (41-T-1640) on the brake-apply shaft.

g. INSTALLATION OF LEFT END COVER.

- (1) Apply sealing compound to the split line of the left end cover. Check to see that there are two "O" ring gaskets on the split line. Attach the hoist to the lifting eye of the left end cover and position it near the left end plate. Make sure the thimble (41-T-1640) is over the brake-apply shaft (fig. 394).
- (2) Install the left end cover, rotating the steering shafts in the rear of the transmission. This is done to engage the splines of the left steering cross shaft

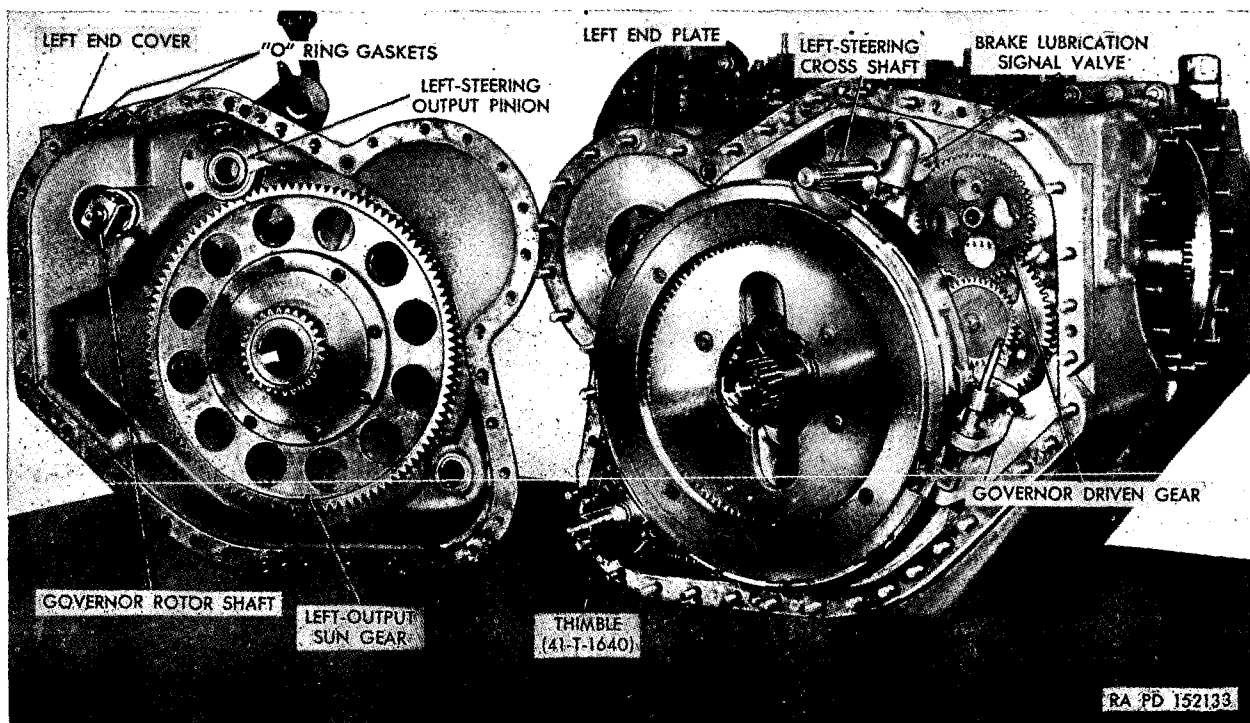


Figure 394. Thimble installed on left brake-apply shaft.

with the steering-output pinion. See that the splines of the governor-rotor shaft engage with the governor driven gear.

Note. If the steering clutch assembly is in the transmission, remove the steering-differential inspection plate on top of the transmission and use a screwdriver to turn the gear.

- (3) Use a soft hammer to tap the end cover into place. Remove the thimble from the brake-apply shaft. Install the brake-adjustment-cover and gasket. Secure the cover to the end cover with three $\frac{5}{16}$ -inch bolts and washers. Torque the bolts 17 to 20 pound-feet. Install 38 washers, $\frac{1}{2}$ -inch nuts, and jam nuts on the studs to secure the left end cover to the transmission. Torque the nuts 42 to 50 pound-feet.
- (4) Apply heavy grease to the output shaft. Install the output flange on the output shaft. When installing the flange, line up the grooves on the external face of the flange with the slots on the output shaft. Install the output-flange lock screw and copper gasket in the flange. Apply 150 to 200 pound-feet torque to the lock screw. Install locking wire to secure the screw.
- (5) Install the brake-apply arm and snap ring on the brake-apply shaft.
- (6) Check the output-flange end play on both output flanges. If the output flange is not seated properly, tap on the center of the flange with a soft hammer. Using a depth micrometer, measure and record the distance from the machined surface on the outside of the flange to the machined surface on the end cover.
- (7) Using a screwdriver or pry bar, pry the flange outward. Again measure and record, at the same place, the distance from the outside of the flange to the end cover. The difference in the two measurements is the end play of the output flange. The end play should be between 0.012 and 0.035 inch at each output flange. If the output-flange end play is not within the limits, remove the end cover and determine the cause. The

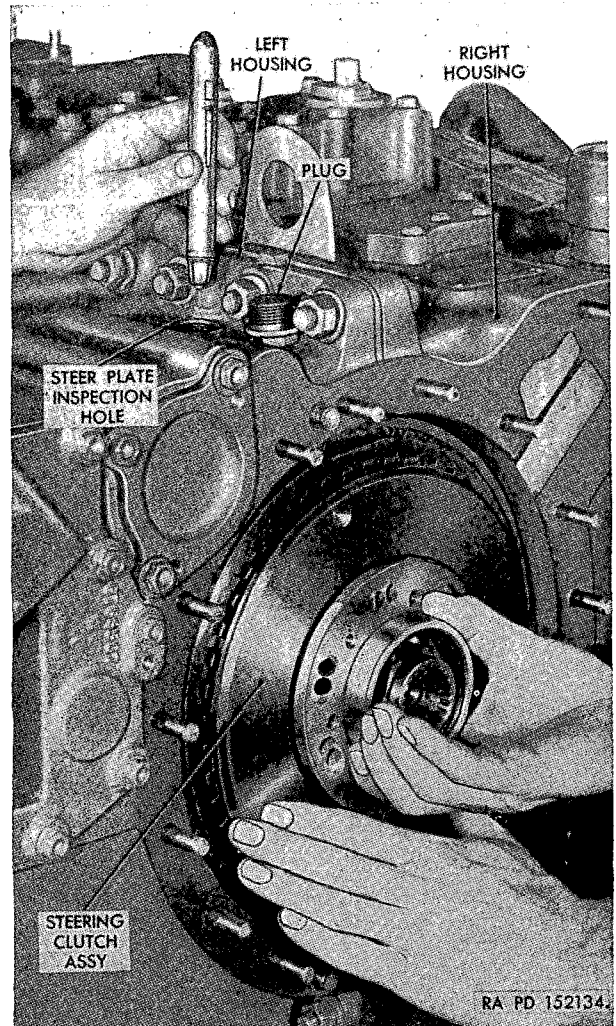


Figure 395. Inspecting right steering clutch installation.

shims which determine the end play are located behind the left output ring gear. Refer to figure 63.

h. INSTALLATION OF STEERING CLUTCH PACK.

- (1) Remove the steer-plate-inspection-hole plug. Install the steering clutch assembly, rotating it slightly. Look into the steer-plate-inspection hole to see that the disks of the right steering clutch align with the right steering shaft (fig. 395).
- (2) Secure the steering clutch assembly in the left steering-clutch-shaft drum with a snap ring between the left drum and the left clutch ring (fig. 47). To align the oil passages in the sleeve and cover,

install a $\frac{5}{16}$ -inch guide bolt in the oil transfer sleeve between the right and left steering oil holes.

- (3) Check the two "O" gaskets on the rear cover. Install the rear cover and gasket (fig. 46), using the guide bolt to align the oil passages. Secure the cover to the transmission with eighteen $\frac{3}{8}$ -inch nuts, jam nuts, and washers. Torque the nuts 17 to 20 pound-feet.
- (4) With the two gaskets in place, install the coolant pump manifold on the cover and transmission housing (fig. 44). Secure with six $\frac{5}{16}$ -inch bolts and washers in the center of the manifold and three $\frac{5}{16}$ -inch

bolts and washers in the lower right end of the manifold. Torque the bolts 17 to 20 pound-feet.

- (5) With the "O" ring gasket and pump coupling in place, install the steering-clutch coolant pump on the manifold (fig. 43). Secure the pump to the manifold with six $\frac{5}{16}$ -inch bolts. Torque the bolts 17 to 20 pound-feet.

i. INSTALLATION OF CONVERTER OIL FILTER.

Install the converter oil filter assembly and gasket on the valve body (fig. 42). Secure the filter with seven $\frac{3}{8}$ -inch nuts, jam nuts, and washers. Torque the nuts 17 to 20 pound-feet. Install the input shaft coupling (fig. 40).

Section XX. TESTS AND ADJUSTMENTS OF TRANSMISSION

90. Preliminary Instructions

a. TEST EQUIPMENT. To conduct the tests outlined in this section, the equipment listed in (1) through (5) below is needed.

- (1) A test stand for mounting the power package (engine, transmission, and coolers), and engine tachometer and two hand tachometers.
- (2) A mechanism (levers and air operated piston) for applying the service brakes. This mechanism must apply 240 pound-feet torque to the two brake-apply shafts simultaneously.
- (3) Nine oil pressure gages (45-G-438-500) with a capacity of 200 psi and one with a capacity of 100 psi (fig. 396). These gages should be mounted on a panel.
- (4) One temperature gage with readings up to 400° F.
- (5) Mechanism (set of bellcranks) for operating the shift shaft and the steering shaft.

b. TEST DATA LOG. A simple test data log on which all necessary data may be recorded should be available. Figure 397 shows a log which may be used during testing.

91. Tests

a. GENERAL. This paragraph outlines the tests and checks that should be given to all rebuilt or deadlined transmissions (par. 14).

b. INSTALLATION OF TRANSMISSION ON STAND. Install the transmission on the test stand. Be sure all necessary connections to the valve body and other parts of the transmission are correctly made (par. 21b). Make certain the brakes are correctly adjusted (par. 92a). Arrange the equipment and instruments to obtain the test data listed in (1) through (13) below.

- (1) Input speed (2,800 rpm max).

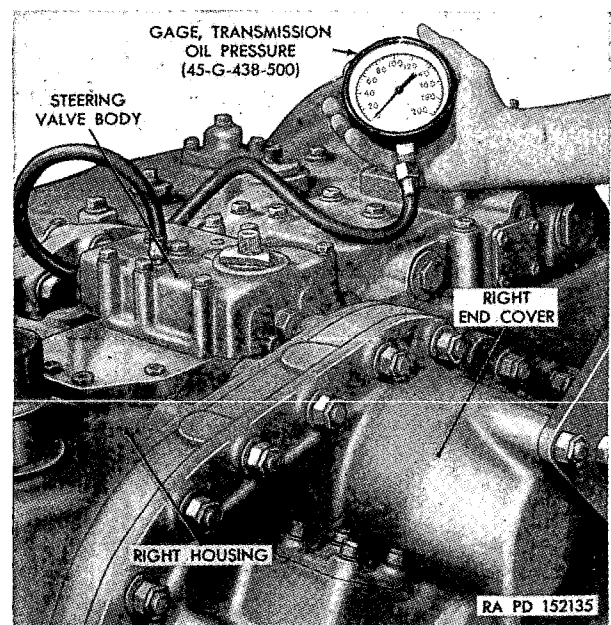


Figure 396. Checking transmission oil pressures.

TRANSMISSION TEST DATA SHEET

MODEL NO. _____ SERIAL NO. _____ PAGE NO. _____

TEST NO. _____								
INPUT SPEED _____								
OUTPUT SPEED _____								
MAIN OIL PRESS. _____								
CONVERTER "OUT" PRESS. _____								
CONVERTER "IN" PRESS. _____								
CONVERTER "OUT" TEMP. _____								
LUBE. PRESS. _____								
HIGH-RANGE CLUTCH PRESS. _____								
LOW-RANGE CLUTCH PRESS. _____								
REVERSE-RANGE CLUTCH PRESS. _____								
GOVERNOR OIL PRESS. _____								
L. -STEERING CLUTCH OIL PRESS. _____								
R. -STEERING CLUTCH OIL PRESS. _____								

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Figure 397. Test data log.

- (2) Output speed (2,800 rpm max each side).
- (3) Main oil pressure (200 psi max).
- (4) Converter "OUT" oil pressure (200 psi max).
- (5) Converter "IN" oil pressure (200 psi max).
- (6) Converter "OUT" oil temperature (300° F max).
- (7) Lubrication oil pressure (40 psi max).
- (8) High-range clutch oil pressure (200 psi max).
- (9) Low-range clutch oil pressure (200 psi max).
- (10) Reverse-range clutch oil pressure (200 psi max).
- (11) Governor oil pressure (200 psi max).
- (12) Left steering clutch oil pressure (200 psi max).
- (13) Right steering clutch oil pressure (200 psi max).

c. FUNCTIONAL TEST.

- (1) With the transmission in neutral-range and the service brakes unapplied, run the transmission at an input speed of 1,000 rpm until the main and converter oil pressures are stabilized.
- (2) Check the transmission output flange rotation in all ranges.

Caution: Do not exceed 300 rpm output speed in reverse-range during any tests.

- (3) With transmission in neutral, input speed at 1,000 rpm, service brakes unapplied, shift into right steer and check the rotation of the output flange. In right steer the left output flange should be turning clockwise and the right output flange counterclockwise. Shift into left steer and again check the output flanges. The left output flange should be turning counterclockwise and the right output flange should be turning clockwise.
- (4) While performing the tests in (1) through (3) above, watch for any indication of drag and low oil pressures. Record the instrument readings for: main oil pressure, high-, low-, and reverse-range clutch pressures, converter "IN" and "OUT" pressures, lubrication pressure, right and left steering clutch pressure (max).

Note. All the recorded pressures should come within the limits listed in paragraph 21b unless otherwise specified. If the readings are not within limits, see paragraphs 13 and 14.

d. WARM-UP, SERVICE BRAKE, AND LOW-RANGE STALL TESTS.

- (1) With service brakes fully applied (240 pound-feet torque on each apply arm), shift to low-range.
- (2) Slowly increase the input speed to maximum (full throttle), being careful not to allow main pressure to exceed 200 psi.

Note. The service brakes must be able to keep the output flanges from turning. If the brakes slip, shut down the engine immediately and check the brake adjustment (par. 92a).

If the brake adjustment is correct, remove the end covers and check the brake assemblies.

- (3) Continue to warm-up the transmission until converter "OUT" temperature reaches 280° F. Record the instrument readings for—input speed (2,240 to 2,360 rpm), main oil pressure, low-range clutch pressure, converter "IN" pressure, converter "OUT" pressure, lubrication pressure.

e. LOW-RANGE TEST. With service brakes released, shift to low-range and increase the input speed to 2,800 rpm. Record the readings for: main oil pressure, low-range clutch pressure, converter "OUT" pressure, converter "IN" pressure, lubrication pressure.

f. HIGH-RANGE AND CONVERTER LOCK-UP CLUTCH TEST.

- (1) With the service brakes unapplied, shift into high-range and very slowly increase the output speed by increasing input speed until the converter lock-up clutch engages. Record the output speed (1,900 to 2,200 rpm) and the governor oil pressure (118 psi approximately) just before clutch engagement takes place.
- (2) Increase the input speed to 2,800 rpm and record: output speed, main oil pressure, high-range clutch pressure, converter "OUT" pressure, converter "IN" pressure, lubrication pressure.
- (3) Reduce the output speed by reducing input speed very slowly until the lock-

up clutch disengages. Record the output speed and governor pressure (99 psi aprx.) just before disengagement takes place.

g. STEERING TEST. With the service brakes unapplied and the transmission in neutral-range, increase the input speed to 2,000 rmp. Record the maximum right and left steering clutch oil pressures.

h. OUTPUT PUMP TEST. With the transmission operating in high-range and the brakes unapplied, increase the input speed until the output speed reaches 500 rpm. Shift into neutral range and reduce input speed to 0 (zero) rpm. Record immediately the main oil pressure.

i. LEAK TEST. During all of the above tests, look for oil leaks along the external oil lines, end covers, left and right housings, valve bodies, all split lines, and pipe plug.

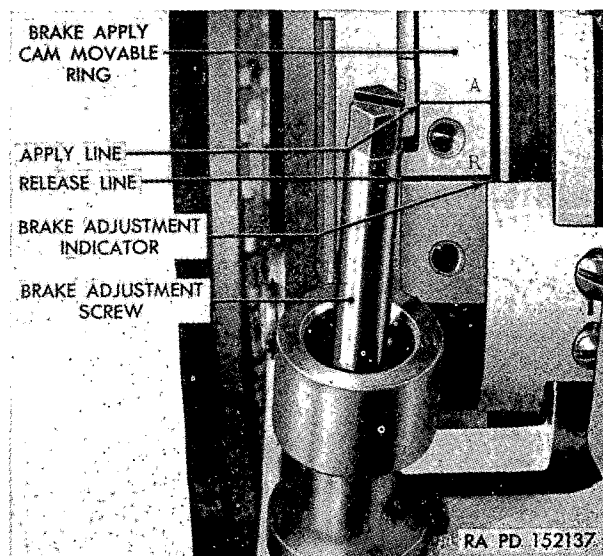


Figure 398. Brake adjustment components.

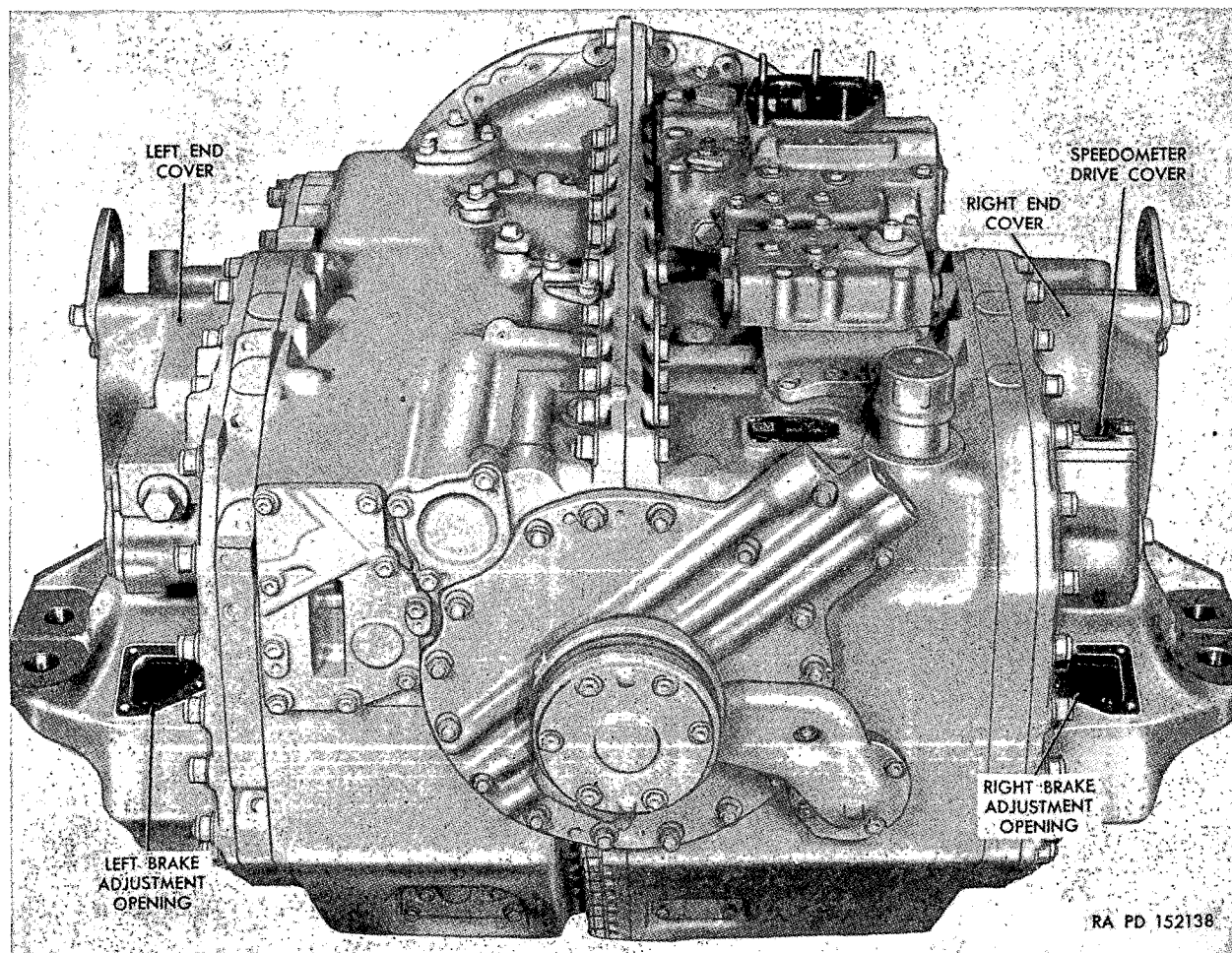


Figure 399. Transmission with brake adjusting covers removed.

j. **SOUND CHECK.** Listen for loud noises, high whine, or clashing during the running of all the above tests.

Note. The normal whine of this type of transmission should not be mistaken for malfunctioning.

92. Adjustments

a. BRAKE ADJUSTMENT PROCEDURE.

- (1) Remove the right brake adjustment cover (fig. 79).
- (2) With the brakes released, look into the brake adjustment opening, checking to see that the "R" line on the brake-apply-cam ring lines up with the top of the indicator (fig. 398).
- (3) If the "R" line does not line up with the indicator, remove the end cover and adjust the indicator so that, with the brakes released, the top edge of the indicator is opposite the line stamped "R."

Note. This check must be made while viewing the indicator at a 45 degree angle above horizontal. (This is the angle at which the indicator is seen through the brake-adjustment opening with the end cover installed.)

Tighten the two screws on the indicator and secure it with lockwire.

- (4) Apply the right brake with 240 pound-feet of torque on the brake apply lever.
- (5) With the right brake fully applied, look into the brake adjustment opening and check the position of the brake-apply-cam ring (fig. 399). The "A" line on the cam ring should line up with the top of the indicator (fig. 398). If it does not, release the brake pedal and proceed with the adjustment.
- (6) If the "A" line stopped below the top of the indicator, use a screwdriver to tighten the brake by turning the adjusting screw in a clockwise direction (fig. 400).
- (7) If the "A" line stopped above the top of the indicator, loosen the brake by turning the adjusting screw in a counter-

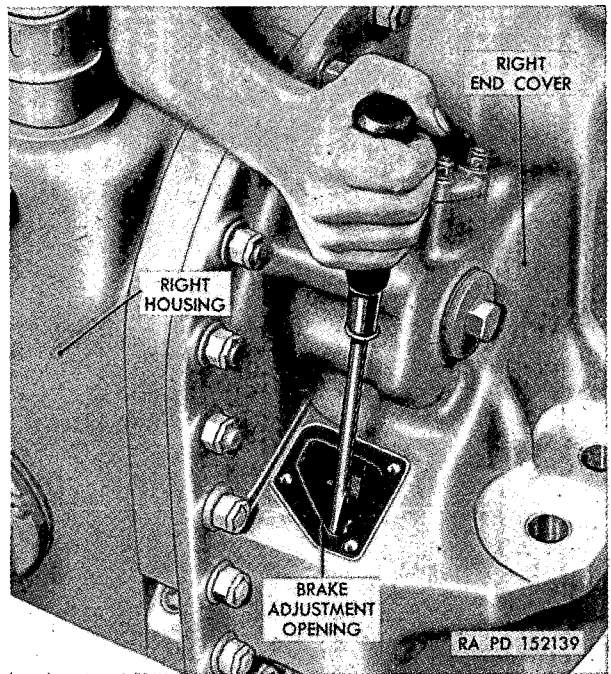


Figure 400. Turning brake adjusting screw.

clockwise direction until the "A" line stops well below the top of the indicator when the brake is fully applied. Then tighten the brake by turning the screw in a clockwise direction until the proper adjustment is obtained.

Caution: Always complete the adjustment while turning the adjusting screw in a clockwise direction. By doing this the backlash is removed from the adjusting mechanism.

- (8) Install the right brake-adjustment cover. A brake-adjusting-screw lock plate is riveted to the cover. It may be necessary to turn the brake-adjusting screw slightly to fit the plate into its proper slot. This locks the brake-adjusting screw in place.
- (9) Adjust the left brake following the procedure in (1) through (7) above.

b. **STEERING VALVE BODY ADJUSTMENT PROCEDURE.** Refer to paragraph 54d for the steering valve body adjustment procedure.

CHAPTER 5

SERVICEABILITY STANDARDS

93. General

The serviceability standards included herein give the minimum, maximum, and key clearances of new or rebuilt parts, as well as wear limits which indicate that point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear limits" column or damaged from corrosion will be approved for service. An asterisk (*) in the "Wear limits" column indicates that the part or parts should be replaced when worn beyond the

limits given in the "Sizes and fits of new parts" column. In the "Sizes and fits of new parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

Note. It will be noted that some "blanks" appear in the "Wear limits" column. These values are not yet available and will be issued in the form of a change or revision to this manual after the transmission has been in service and necessary experience gained. Spur gear backlash figures are included for information only and do not indicate acceptable wear limits.

94. Steering Clutch Pack (Par. 26)

a. INTERNAL SPLINED STEEL DISK GM-6765658.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	B	Amount of cone	0.009 to 0.018	0.007 to 0.021.
401	B	Thickness	0.092 to 0.095	0.090.

b. EXTERNAL SPLINED BRONZE DISK GM-6765659.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	A	Thickness	0.118 to 0.124	0.098.

c. LEFT STEERING CLUTCH PISTON ASSEMBLY GM-6764058.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limit
401	HH	Inside diameter (sleeve)	5.820 to 5.823	5.824.

d. RIGHT STEERING CLUTCH PISTON ASSEMBLY GM-6764059.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	T	Inside diameter (sleeve)	5.820 to 5.823	5.824.

e. STEERING CLUTCH PISTON SLEEVE GM-6765339.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	U	Outside diameter	6.0997 to 6.1002	
401	S	Inside diameter of piston	6.0932 to 6.0942	
	U-S	Fit of sleeve in piston	0.0055T to 0.0070T	0.0050T.

f. STEERING CLUTCH PISTON DOWEL PIN GM-6764932.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	Q	Outside diameter	0.3126 to 0.3128	0.3124.
401	EE	Inside diameter of dowel pin bore in left piston.	0.3133 to 0.3143	0.3153.
401	N	Inside diameter of dowel bore in hub	0.315 to 0.316	0.317.
	Q-EE	Fit of dowel pin in left piston	0.0005L to 0.0017L	
	Q-N	Fit of dowel pin in hub	0.0022L to 0.0034L	



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Figure 401. Serviceability standard points of measurement for steering clutch pack.

g. STEERING CLUTCH PISTON RETURN SPRING GM-6765401.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	X	Free height	1.127 to 1.147	1.110.
401	X	Height under 53.5 to 60.3 lb load	0.945	50 lb at 0.945

h. STEERING CLUTCH INNER HUB ASSEMBLY GM-6764016.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	M	Outside diameter at splined inner rings	5.809 to 5.810	5.808.
401	L	Inside diameter at oil transfer sleeve	2.9995 to 3.0005	3.0015.
401	W	Inside diameter at drive shaft pilot	3.6245	3.6255.

i. LEFT STEERING CLUTCH SPLINED INNER RING—GM-6765300.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	C	Inside diameter of splined inner ring (where splined ring fits on inner hub).	5.8105 to 5.8125	5.8135.
401	M	Outside diameter of inner hub	5.809 to 5.810	5.808.
	C-M	Fit of splined inner ring on inner hub	0.0005L to 0.0035L	0.0055L.

j. RIGHT STEERING CLUTCH SPLINED INNER RING GM-6765299.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	D	Inside diameter of splined inner ring (where splined ring fits on inner hub).	5.8105 to 5.8125	5.8135.
401	M	Outside diameter of inner hub	5.809 to 5.810	5.808.
	D-M	Fit of splined inner ring on inner hub	0.0005L to 0.0035L	0.0055L.

k. STEERING CLUTCH LUBE VALVE SPRING GM-6760328.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	AA	Free height	0.613	0.500.
401	AA	Height under 0.465 to 0.565 lb load	0.3125	0.415 lb. at 0.3125.

l. STEERING CLUTCH LUBE VALVE GM-6760317.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	BB	Outside diameter	0.1855 to 0.1865	0.1845.
401	DD	Diameter of bore in valve seat	0.187 to 0.188	0.189.
	BB-DD	Fit of valve in seat	0.0005L to 0.0025L	0.0035L.

m. STEERING CLUTCH LUBE VALVE SEAT GM-6765487.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	CC	Outside diameter	0.7449 to 0.7454	(*)
401	Z	Inside diameter of bore	0.7436 to 0.7446	0.7451.
	CC-Z	Fit of seat in bore	0.0003T to 0.0018T	

n. STEERING CLUTCH INNER HUB SLEEVE GM-6764003.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	K	Outside diameter	3.755 to 3.7555	
401	P	Inside diameter of inner hub	3.750 to 3.751	
	K-P	Fit in inner hub	0.004T to 0.0035T	0.0035T.

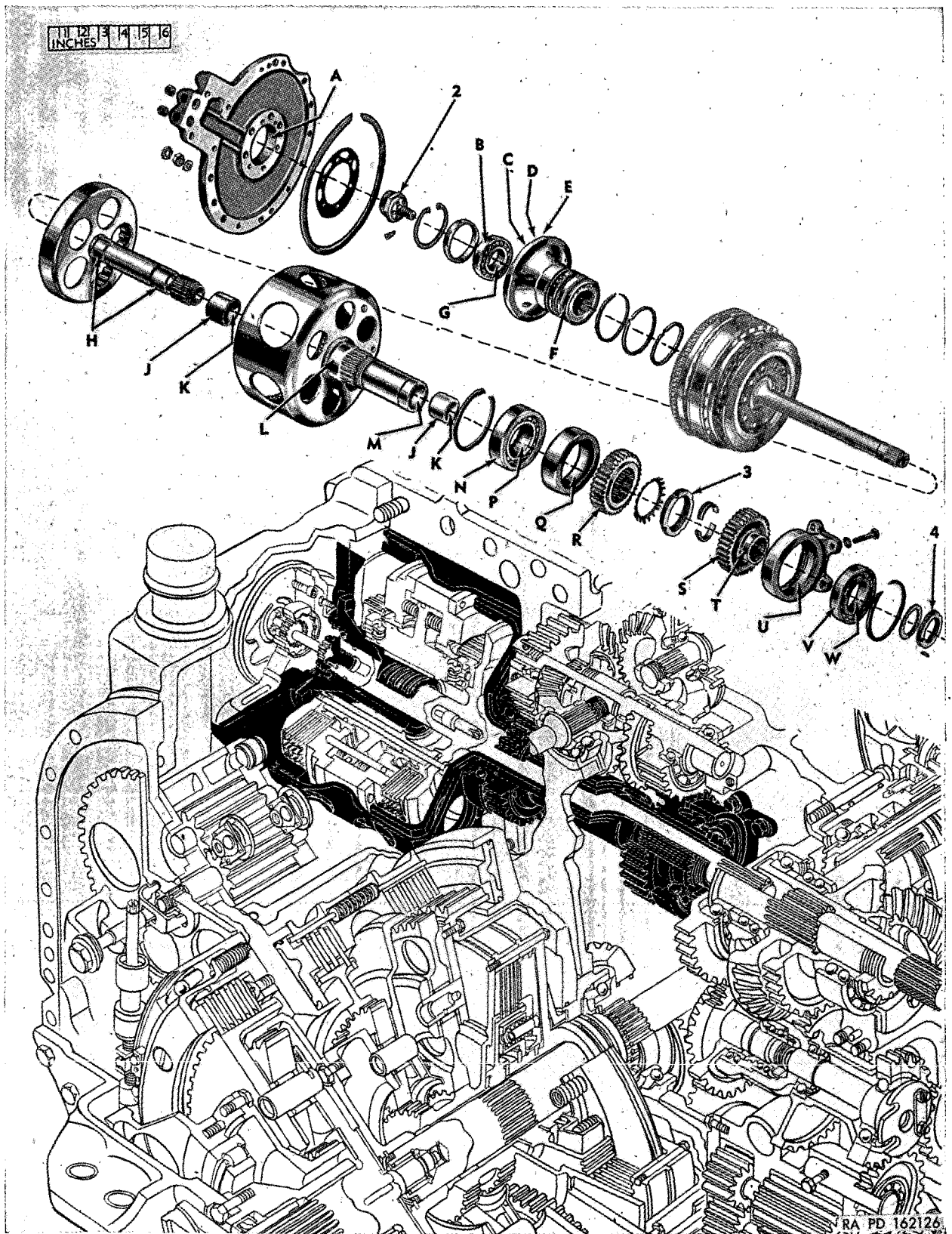


Figure 402. Serviceability standard points of measurement for steering clutch pack and left housing.

o. STEERING CLUTCH OIL TRANSFER SLEEVE GM-6765430.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	F	Outside diameter (inner hub end)-----	2.976 to 2.980-----	2.975.
401	L	Inside diameter of inner hub sleeve-----	2.9995 to 3.0005-----	3.0015.
	F-L	Fit in inner hub sleeve-----	0.0195L to 0.0245L-----	
402	E	Outside diameter (rear cover end)-----	3.2485 to 3.2495-----	3.2475.
402	A	Inside diameter of bore in rear cover-----	3.2495 to 3.2505-----	3.2515.
	E-A	Fit of sleeve in rear cover-----	0.000 to 0.002L-----	0.003L.
402	D	Inside diameter of sleeve at shaft-----	1.687 to 1.688-----	1.689.
401	H	Outside diameter of shaft-----	1.656 to 1.666-----	1.646.
	D-H	Fit of sleeve over shaft-----	0.021L to 0.0321L-----	

p. STEERING CLUTCH SHAFT REAR BEARING GM-903207.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	B	Outside diameter-----	2.8341 to 2.8346-----	2.8336.
402	C	Diameter of bore in oil transfer sleeve-----	2.8345 to 2.8351-----	2.8356.
	B-C	Fit of bearing in sleeve-----	0.0001T to 0.001L-----	0.002L.

q. STEERING CLUTCH DRIVE SHAFT GM-6765378.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
401	F	Outside diameter at rear bearing-----	1.3779 to 1.3784-----	1.3777.
402	G	Inside diameter of bearing-----	1.3775 to 1.3780-----	(*).
	F-G	Fit of bearing on shaft-----	0.0001L to 0.0009T-----	0.0003L.
401	E	Small inside diameter at lube oil orifice-----	0.3698 to 0.3708-----	0.3718.
401	G	Small outside diameter of orifice-----	0.369 to 0.370-----	0.368.
	E-G	Fit of orifice in shaft (small bore)-----	0.0002T to 0.0018L-----	0.0028L.

95. Pressure Control Valve and Oil Filter

(Par. 30)

a. LUBE CONTROL VALVE SPRING GM-6765438.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	D	Free height-----	3.813-----	
403	D	Height under 13.5 to 16.5 lb load-----	1.937-----	12.7 lb at 1.937.

b. LUBE CONTROL VALVE GM-6763821.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	E	Outside diameter-----	1.1235 to 1.1240-----	1.1230.
403	C	Diameter of bore in sleeve-----	1.1245 to 1.1255-----	1.1260.
	E-C	Fit of valve in sleeve-----	0.0005L to 0.0020L-----	0.0030L.

c. LUBE CONTROL VALVE SLEEVE GM-6763809.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	B	Outside diameter-----	1.3740 to 1.3745-----	1.3735.
403	A	Diameter of bore in valve body-----	1.3745 to 1.3755-----	1.3760.
	B-A	Fit of sleeve in valve body-----	0.000 to 0.0015L-----	0.0020L.

d. LUBE CONTROL VALVE STOP GM-6764590.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	F	Outside diameter of stop-----	1.364 to 1.369-----	1.359.
403	A	Diameter of bore in valve body-----	1.3745 to 1.3755-----	1.3760.
	F-A	Fit of stop in valve body-----	0.0055L to 0.0115L-----	

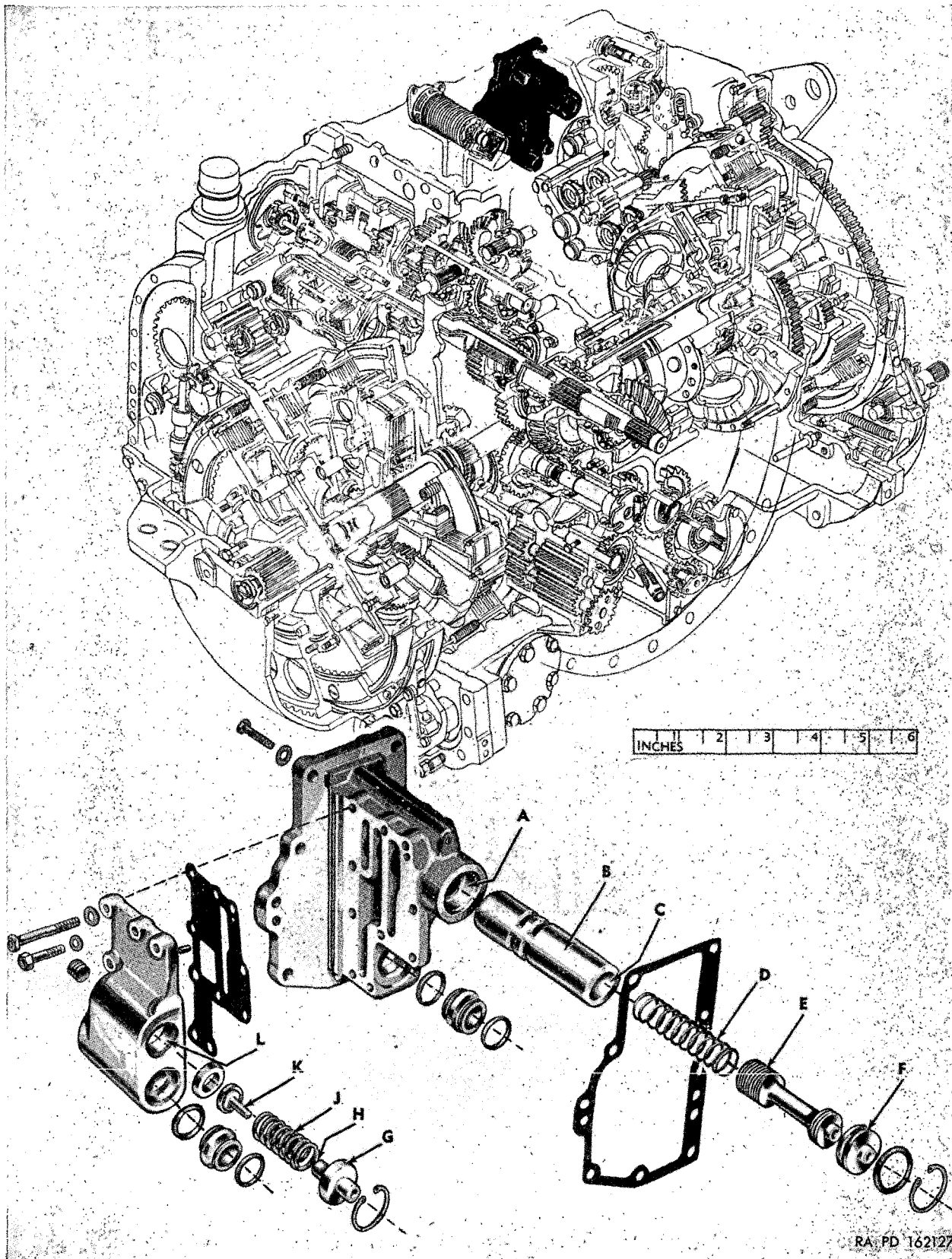


Figure 403. Serviceability standard points of measurement for pressure control valve.

e. BRAKE PRESSURE REGULATOR VALVE SPRING GM-6765415.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	J	Free height.....	1.838.....	
403	J	Height under 50.3 to 61.3 lb load.....	0.938.....	47.5 lb at 0.938.

f. BRAKE PRESSURE REGULATOR VALVE GM-6766189.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	K	Outside diameter at guide.....	$\frac{7}{32}$	0.198.

g. BRAKE PRESSURE REGULATOR VALVE GUIDE GM-6765414.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
403	H	Inside diameter.....	$\frac{5}{32}$	0.270.
	K-H	Fit on valve.....	$\frac{1}{32}$ L.....	
403	G	Outside diameter.....	1.2530 to 1.2535.....	1.2525.
403	L	Diameter of bore in valve cover.....	1.252 to 1.253.....	1.254.
	G-L	Fit of guide in valve cover.....	0.000 to 0.0015T.....	0.0010L.

h. MAIN OIL FILTER RELIEF VALVE OUTER SPRING GM-6764154.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
404	A	Free height.....	1.33.....	
404	A	Height under 54 to 60 lb load.....	$\frac{3}{4}$	52.5 lb at $\frac{3}{4}$.

i. MAIN OIL FILTER RELIEF VALVE INNER SPRING GM-6765759.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
404	B	Free height.....	1.25.....	
404	B	Height under 32.5 to 35.5 lb load.....	$\frac{3}{4}$	31.7 lb at $\frac{3}{4}$.

96. Left End Cover

(Par. 34)

a. STEERING PINION INNER BEARING CAGE GM-6704161.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	B	Outside diameter.....	3.873 to 3.874.....	3.872.
405	J	Diameter of bore in end cover.....	3.8745 to 3.8755.....	3.8765.
	B-J	Fit of cage in bore.....	0.005L to 0.0025L.....	0.0035L.

b. STEERING PINION OUTER BEARING CAGE GM-6704145.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	H	Outside diameter.....	3.2485 to 3.2495.....	3.2475.
405	K	Diameter of bore in end cover.....	3.2495 to 3.2505.....	3.2515.
	H-K	Fit of cage in bore.....	0.000 to 0.002L.....	0.003L.

c. STEERING OUTPUT PINION GEAR BEARINGS GM-7450040.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	C	Outside diameter.....	2.9523 to 2.9528.....	2.9518.
405	A	Diameter of bore in inner cage.....	2.9528 to 2.9538.....	2.9543.
	C-A	Fit of bearing in cage.....	0.000 to 0.0015L.....	0.0035L.
405	G	Diameter of bore in outer cage.....	2.9528 to 2.9538.....	2.9543.
	C-G	Fit of bearing in cage.....	0.000 to 0.0015L.....	0.0035L.

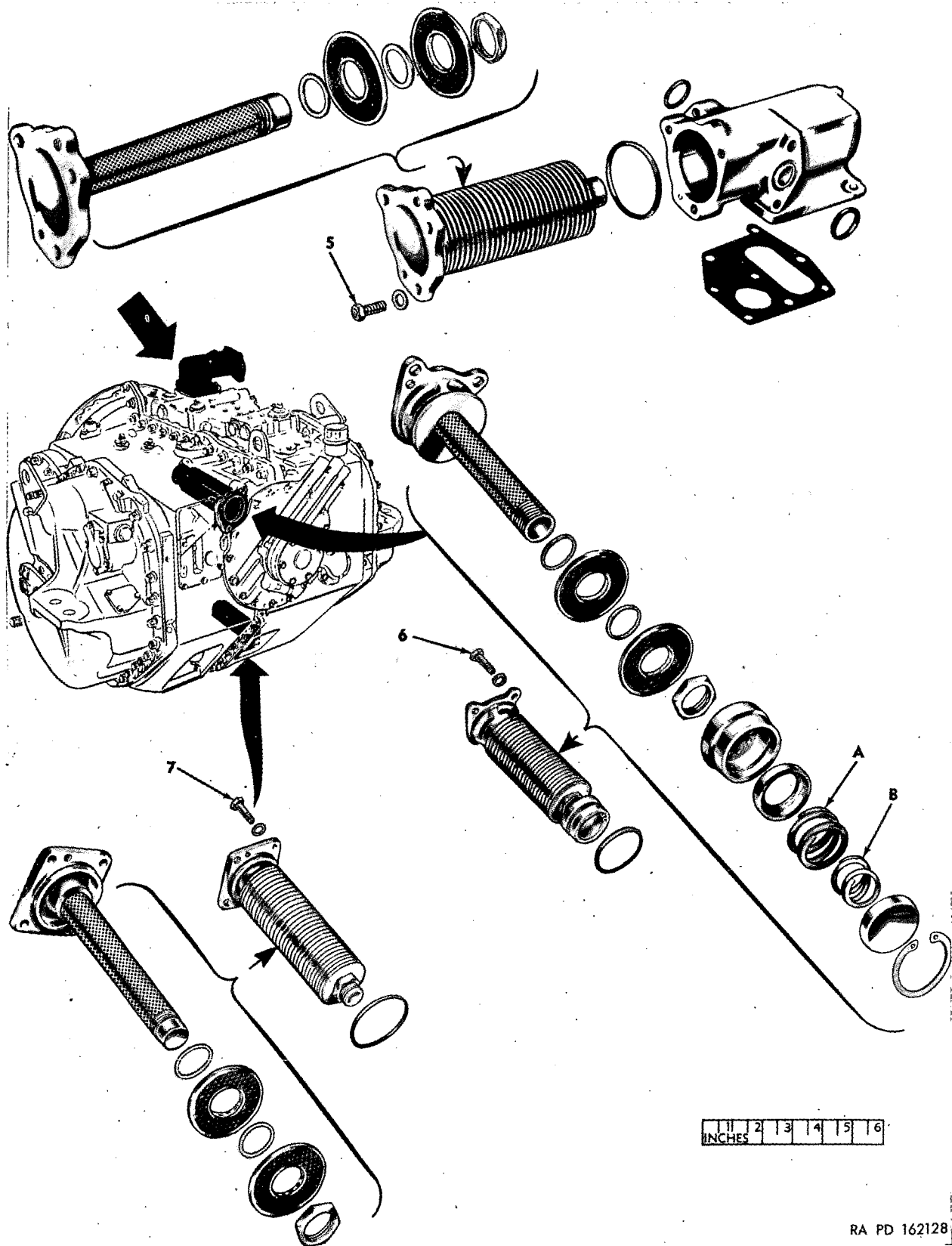


Figure 404. Serviceability standard points of measurement for oil filters.

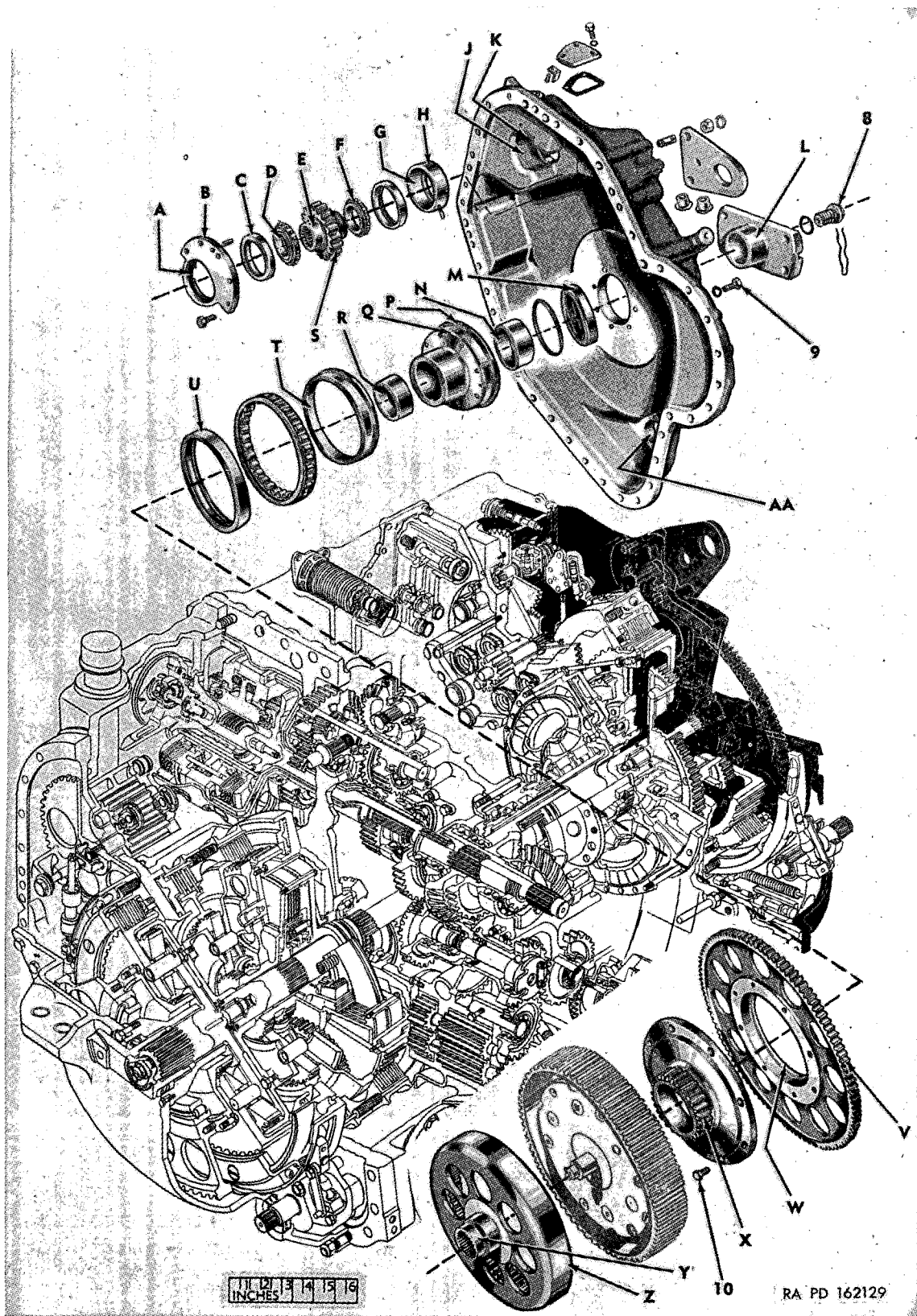


Figure 405. Serviceability standard points of measurement for left end cover.

d. STEERING OUTPUT PINION GM-6704110.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	E	Outside diameter of bearing shoulders---	1.7722 to 1.7728-----	1.7720.
405	D	Inside diameter of bearing-----	1.7712 to 1.7717-----	(*)
	E-D	Fit of pinion in bearing-----	0.0005T to 0.0016T-----	0.0003T.
405	S	Backlash with steering output pinion on standard centers.	0.006 to 0.012-----	

e. STEERING OUTPUT GEAR GM-6764061.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	V	Backlash with steering output pinion gear on standard centers.	0.006 to 0.015-----	

f. STEERING OUTPUT GEAR BEARING GM-6761442.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	U	Outside diameter-----	8.2665 to 8.2677-----	8.2662.
405	W	Inside diameter of bearing bore in steering output gear.	8.2665 to 8.2675-----	8.2678.
	U-W	Fit of bearing in bore-----	0.0012T to 0.001L-----	0.0016L.

g. END COVER HUB GM-6704104.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	Q	Outside diameter at steering output gear bearing.	5.9041 to 5.9047-----	5.9036.
405	T	Inside diameter of bearing-----	5.9045 to 5.9055-----	5.9060.
	Q-T	Fit of bearing on hub-----	0.0014L to 0.0002T-----	0.0024L.

h. OUTPUT SUN GEAR GM-6704118.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	X	Backlash with output planet pinion gears on standard centers.	0.006 to 0.012-----	

i. OUTPUT SHAFT BUSHING GM-6704167.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	M	Outside diameter of shaft-----	2.6215 to 2.6225-----	2.6205.
405	R	Inside diameter of bushing after boring--	2.6255 to 2.6265-----	2.6275.
	M-R	Fit of shaft in bushing-----	0.003L to 0.005L-----	0.007L.

j. OUTPUT FLANGE OIL SEAL GM-6704106.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	M	Outside diameter-----	4.008 to 4.010-----	(*)
405	P	Inside diameter of bore in end cover hub--	4.0025 to 4.0045-----	4.0065.
	M-P	Fit in end cover hub-----	0.0075T to 0.0035T-----	0.0025T.

k. OUTPUT FLANGE—GM-6764586.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	L	Outside diameter of journal-----	3.121 to 3.122-----	3.120.
405	N	Inside diameter of bushing after boring--	3.126 to 3.137-----	3.128.
	L-N	Fit of flange in bushing-----	0.004L to 0.006L-----	0.008L.

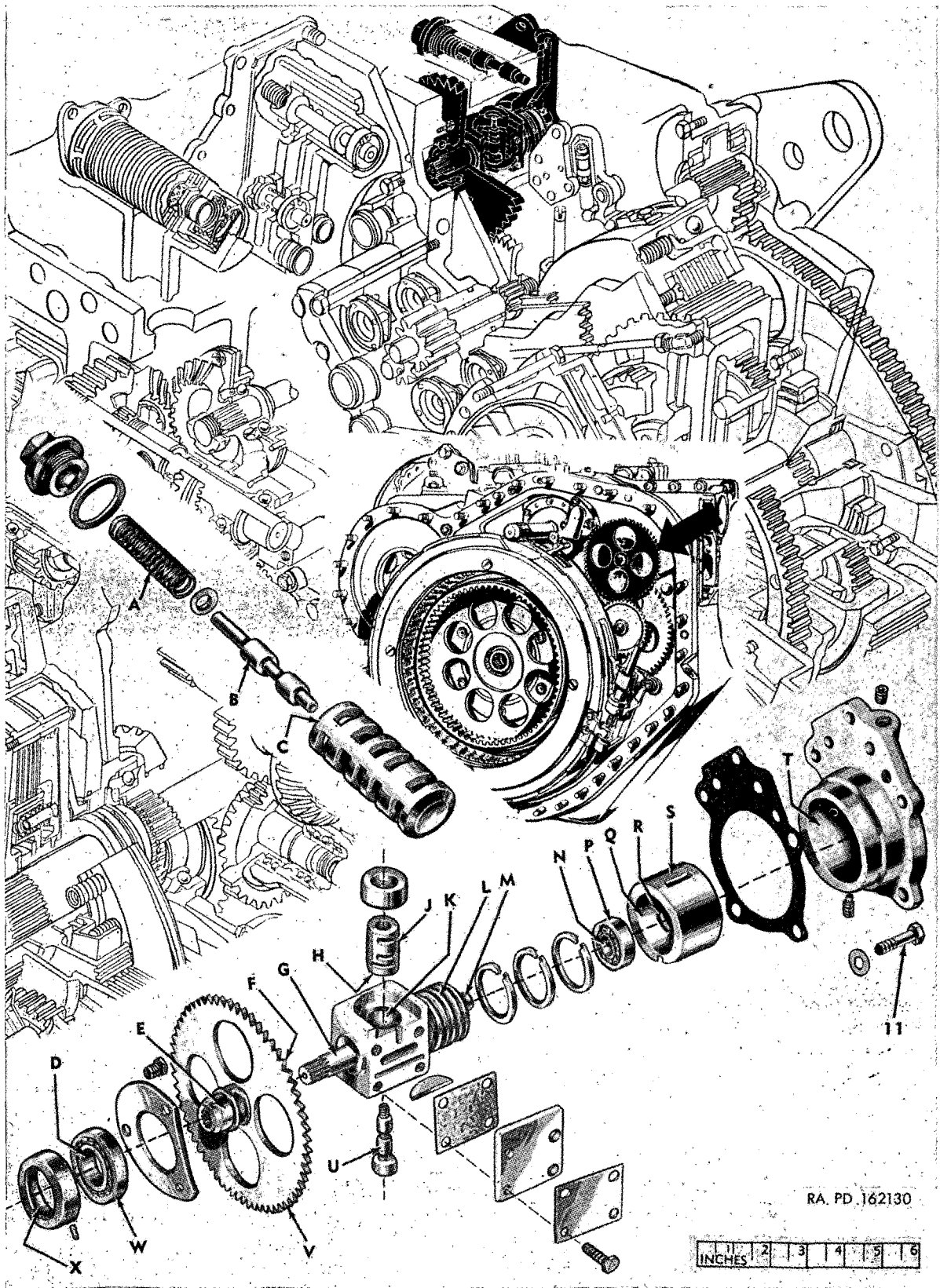


Figure 406. Serviceability standard points of measurement for left end cover.

l. CONVERTER LOCK-UP GOVERNOR ROTOR GM-6763886.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	M	Outside diameter of governor rotor bearing journal.	0.3936 to 0.3939-----	0.3934.
406	N	Inside diameter of governor rotor bearing.	0.3934 to 0.3937-----	(*).
	M-N	Fit of journal in bearing-----	0.0005T to 0.0001L-----	0.0003L.
406	L	Outside diameter of governor rotor valve surface.	1.483 to 1.488-----	1.478.
406	Q	Inside diameter of body cover insert-----	1.500 to 1.501-----	1.502.
	L-Q	Fit of rotor valve in insert-----	0.012L to 0.018L-----	
406	G	Outside diameter of rotor shaft at gear end.	0.5610 to 0.5615-----	0.5605.
406	F	Inside diameter of governor driven gear--	0.562 to 0.563-----	0.564.
	G-F	Fit of shaft in gear-----	0.0005L to 0.002L-----	0.0035L.

m. GOVERNOR PLUNGER GM-8609378.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	U	Outside diameter-----	0.3735 to 0.3740-----	0.3730.
406	H	Diameter of bore in governor body bushing.	0.3745 to 0.3755-----	0.3760.
	U-H	Fit of plunger in bushing-----	0.0005L to 0.002L-----	0.003L.

n. GOVERNOR BODY BUSHING GM-8609439.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	J	Outside diameter-----	0.8105 to 0.8115-----	0.8100.
406	K	Diameter of bore in governor rotor-----	0.812 to 0.813-----	0.8135.
	J-K	Fit of bushing in rotor-----	0.0005L to 0.0025L-----	0.0035L.

o. GOVERNOR BODY COVER INSERT GM-6763908.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	S	Outside diameter-----	2.1260 to 2.1265-----	
406	T	Diameter of bore in governor body cover--	2.1245 to 2.1255-----	
	S-T	Fit of insert in cover-----	0.0005T to 0.002T-----	

p. GOVERNOR ROTOR BEARING GM-903200.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	P	Outside diameter-----	1.1807 to 1.1811-----	1.1802.
406	R	Diameter of bore in governor body cover insert.	1.1810 to 1.1815-----	1.1820.
	P-R	Fit of bearing in insert-----	0.0001T to 0.0008L-----	0.0018L.

q. GOVERNOR DRIVEN GEAR GM-6764887.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	E	Outside diameter of gear at bearing-----	0.9842 to 0.9846-----	0.9840.
406	D	Inside diameter of bearing-----	0.9839 to 0.9843-----	(*)
	E-D	Fit of gear in bearing-----	0.0001L to 0.0007T-----	0.0003L.
406	V	Backlash with governor drive gear on standard centers.	0.006 to 0.012-----	

7. CONVERTER LOCK-UP GOVERNOR RELAY VALVE SPRING GM-6763927.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	A	Free height.....	3.103.....	
406	A	Height under 27 to 33 lb load.....	1.390.....	25.5 lb at 1.390.

8. GOVERNOR RELAY VALVE GM-6763938.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	B	Outside diameter.....	0.5295 to 0.5300.....	0.529.
406	C	Diameter of bore in relay valve sleeve...	0.5305 to 0.5315.....	0.532.
	B-C	Fit of valve in sleeve.....	0.0005L to 0.002L.....	0.003L.

t. OUTPUT PLANETARY THRUST WASHER GM-6704111.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	U	Thickness.....	0.061 to 0.063.....	0.057.

u. OUTPUT SHAFT PILOT BEARING INNER RACE GM-6761283.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	T	Outside diameter.....	1.2495 to 1.250.....	1.2490.
407	P	Inside diameter of output shaft pilot bearing.	1.25.....	
	T-P	Fit of race in bearing.....	0.000 to 0.0005L.....	
407	V	Outside diameter of output shaft pilot...	0.999 to 0.9995.....	0.9895.
407	S	Inside diameter of inner race.....	0.9995 to 1.000.....	1.0005.
	V-S	Fit of race on pilot.....	0.000 to 0.001L.....	0.002L.

v. OUTPUT SHAFT OIL RING GM-8892873.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	R	Thickness.....	0.0925 to 0.0935.....	0.0885.

w. OUTPUT PLANETARY THRUST WASHER GM-6763987.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	L	Thickness.....	0.061 to 0.063.....	0.057.

x. OUTPUT PLANET PINION GEAR THRUST WASHER GM-6704170.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	A	Thickness.....	0.061 to 0.063.....	0.057.

y. OUTPUT PLANET PINION BEARING SPACER GM-6704169.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	G	Thickness.....	0.135 to 0.137.....	0.134.
407	B	Inside diameter.....	1.132 to 1.134.....	1.135.
407	H	Outside diameter of spindle.....	1.1299 to 1.1302.....	1.1294.
	B-H	Fit of spacer on spindle.....	0.0018L to 0.0041L.....	

z. OUTPUT PLANET PINION BEARING (ROLLERS) GM-6704426.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	D	Outside diameter.....	0.1873 to 0.1875.....	0.1871.

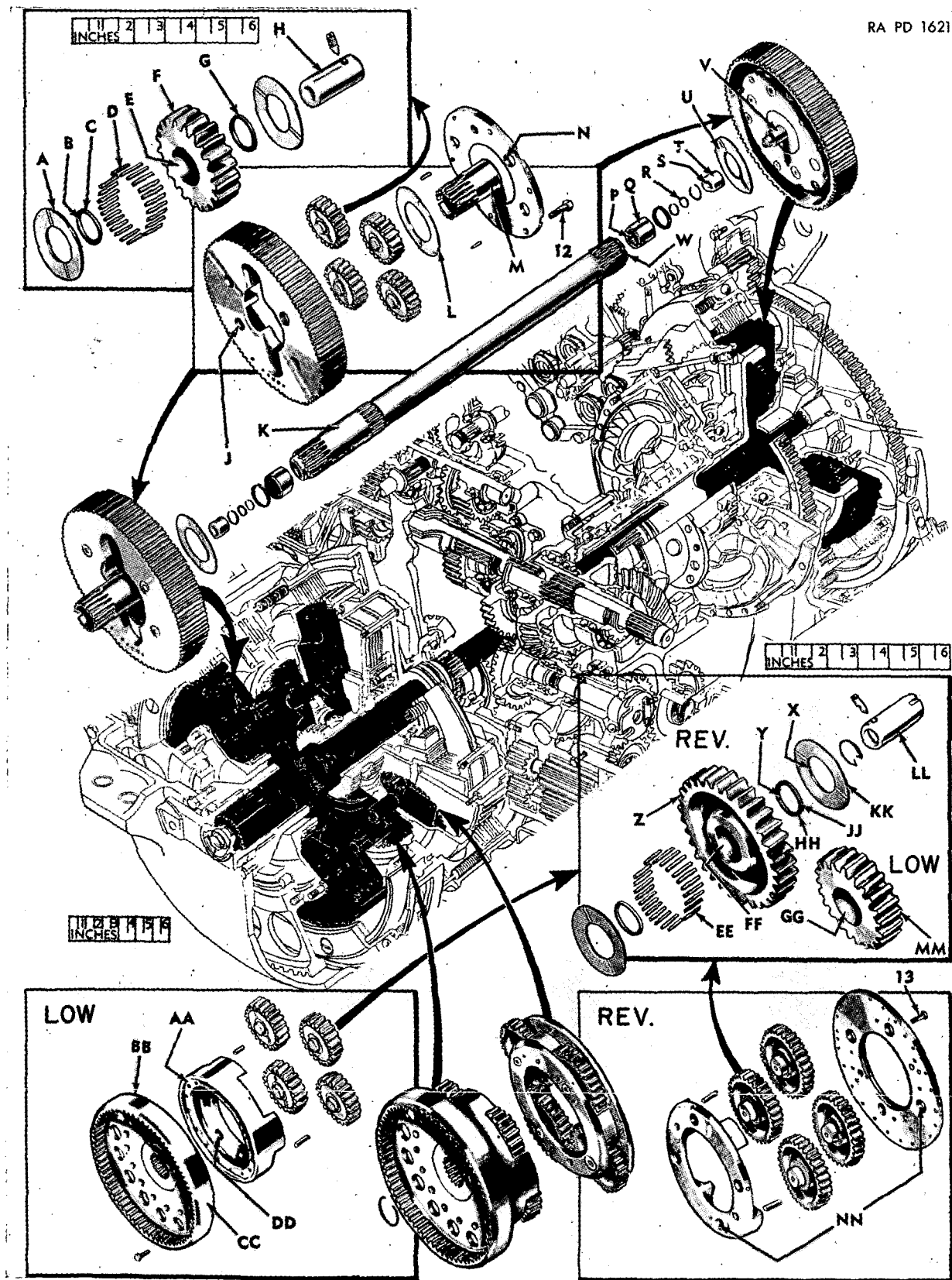


Figure 407. Serviceability standard points of measurement for left end cover.

aa. OUTPUT PLANET PINION GM-6704115.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	F	Width-----	1.150 to 1.153-----	1.149.
407	E	Inside diameter-----	1.5060 to 1.5065-----	1.5070.
407	C	Outside diameter of bearing space-----	1.502 to 1.504-----	1.501.
	E-C	Fit of pinion over spacer-----	0.0020L to 0.0045L-----	
407	F	Backlash with output ring gears on standard centers.	0.006 to 0.012-----	

ab. OUTPUT PLANT PINION SPINDLE GM-6763895.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	H	Outside diameter-----	1.1299 to 1.1302-----	1.1297.
407	N	Inside diameter of bore in output shaft-----	1.1297-----	1.1302.
	H-N	Fit of spindle in output shaft-----	0.0002T to 0.0005T-----	
407	J	Inside diameter of bore in carrier-----	1.1297-----	1.1302.
	H-J	Fit of spindle in carrier-----	0.0002T to 0.0005T-----	

97. Left End Plate

(Par. 38)

a. BRAKE PLATE RELEASE SPRING GM-8894407.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
410	N	Free height-----	1 ⁴⁷ / ₆₄ -----	
410	N	Height under 16.5 to 18.5 lb load-----	1 ¹¹ / ₃₂ -----	16 lb at 1 ¹¹ / ₃₂ .

b. BRAKE FIXED PRESSURE PLATE GM-6704125.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
410	L	Thickness-----	0.281 to 0.277-----	0.267.

c. INTERNAL SPLINED DISK GM-6765641.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
410	M	Outside diameter-----	16 ²⁷ / ₆₄ to 16 ²⁹ / ₆₄ -----	
410	M	Thickness-----	0.122 to 0.126-----	0.120.

d. EXTERNAL SPLINED DISK GM-6763906.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
410	Q	Thickness-----	0.163 to 0.158-----	0.138.

e. BRAKE FLOATING PRESSURE PLATE GM-6763956.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
410	P	Thickness-----	0.434 to 0.438-----	0.424.

f. BRAKE ADJUSTING SCREW GM-6765470.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
409	G	Outside diameter (1)-----	0.372 to 0.373-----	0.371.
409	H	Outside diameter (2)-----	0.4955 to 0.4965-----	0.4945.
409	E	Inside diameter of brake adjusting bracket (1).-----	0.3745 to 0.3755-----	0.3765.
409	F	Inside diameter of brake adjusting bracket (2).-----	0.4975 to 0.5005-----	0.5015.
	G-E	Fit of screw in bracket (1)-----	0.0015L to 0.0035L-----	0.0055L.
	H-F	Fit of screw in bracket (2)-----	0.001L to 0.005L-----	0.007L.

g. BRAKE APPLY CAM RETURN SPRING GM-6703459.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
411	B	Free height.....	6 ³ / ₄	
411	B	Height under 48.5 to 58.5 lb load.....	5 ²⁹ / ₃₂	46 lb at 5 ²⁹ / ₃₂ .

h. BRAKE SHAFT BRACKET NEEDLE BEARING GM-444916.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
411	E	Diameter of shaft.....	1.1250 to 1.1235.....	1.1235.
411	G	Diameter of bore in bracket.....	1.3745 to 1.3755.....	1.3760.

i. BRAKE SHAFT INNER BRACKET NEEDLE BEARING GM-6702341.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
411	F	Diameter of shaft.....	0.875 to 0.8755.....	0.8745.
411	J	Diameter of bore in inner bracket.....	1.1245 to 1.1255.....	1.1260.

j. BRAKE APPLY SHAFT OIL SEAL GM-6700577.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
411	D	Outside diameter of shaft at oil seal.....	1.240 to 1.250.....	1.235.
411	C	Outside diameter of oil seal.....	2.002 to 2.006.....	
405	AA	Inside diameter of end cover bore.....	1.999 to 2.001.....	
	C-AA	Fit of oil seal in end cover bore.....	0.001T to 0.007T.....	

k. BRAKE COOLING OIL VALVE GM-6764566.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
411	A	Outside diameter.....	0.6860 to 0.6865.....	0.6855.
411	H	Diameter of bore in inner bracket.....	0.687 to 0.688.....	0.689.
	A-H	Fit of valve in bracket.....	0.0005L to 0.002L.....	0.003L.

l. BRAKE SIGNAL VALVE GM-6764609.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
408	D	Outside diameter.....	0.4985 to 0.499.....	0.4980.
408	C	Diameter of bore in sleeve.....	0.4995 to 0.5005.....	0.5015.
	D-C	Fit of valve in sleeve.....	0.0005L to 0.002L.....	0.003L.

m. BRAKE SIGNAL VALVE SLEEVE GM-6764608.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
408	B	Outside diameter.....	0.749 to 0.7495.....	0.7485.
408	A	Diameter of bore in brake signal valve body.....	0.7495 to 0.7505.....	0.7515.
	B-A	Fit of sleeve in body.....	0.000 to 0.0015L.....	0.0025L.

n. GOVERNOR DRIVEN GEAR BEARING GM-903005.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
406	W	Outside diameter.....	1.8499 to 1.8504.....	1.8594.
406	X	Inside diameter of governor driven bearing cage.....	1.8503 to 1.8509.....	1.8514.
	W-X	Fit of bearing in cage.....	0.0001T to 0.001L.....	0.002L.

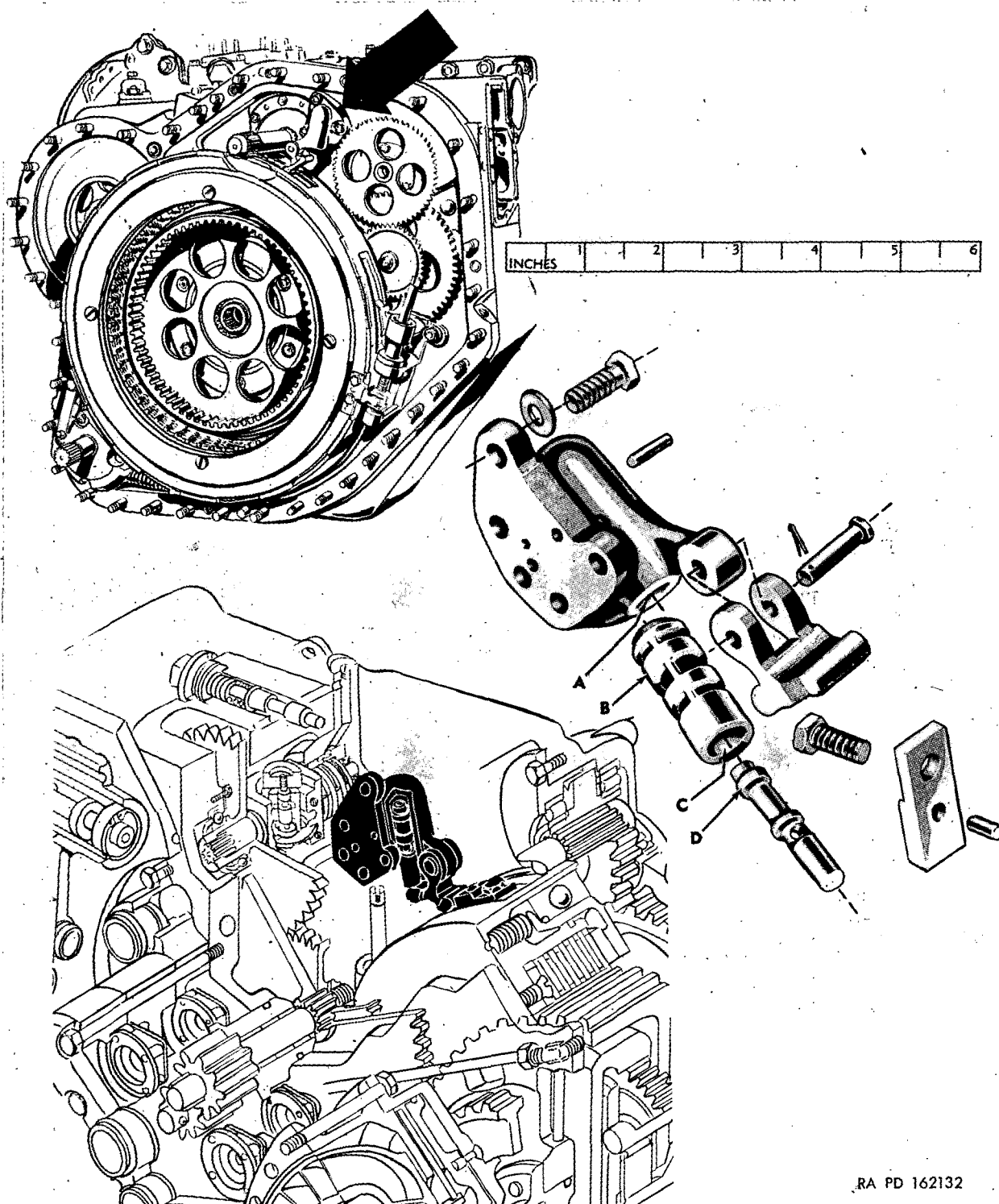


Figure 408. Serviceability standard points of measurement for left end plate.

o. LEFT OUTPUT RING GEAR GM-6763766.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
405	Y	Outside diameter of hub	2½	
413	G	Inside diameter of converter-turbine shaft	2½ ₁₆	
	Y-G	Fit of gear hub in shaft	¼ ₁₆ L	
405	Z	Backlash with output planet pinion on standard centers.	0.006 to 0.012	

p. OUTPUT SHAFT PILOT BEARING GM-6760161.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	Q	Outside diameter	Press fit in cross-drive shaft.	
	W	Diameter of bore in cross-drive shaft	1.4995 to 1.5005	1. 5015.

Note.—For the serviceability standards of the output brake and pressure pump refer to paragraph 107.

98. Torque Converter

(Par. 42)

a. CONVERTER LOCK-UP CLUTCH HOUSING BEARING GM-453679.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	HH	Outside diameter	6.4951 to 6.4961	6.4946.
410	J	Inside diameter of retainer	6.4963 to 6.4973	6.4978.
	HH-J	Fit of bearing in retainer	0.0002L to 0.0022L	0.0032L.

b. CONVERTER PUMP DRIVE GEAR GM-6763782.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	EE	Backlash with converter drive gear on standard centers.	0.006 to 0.012	

c. CONVERTER LOCK-UP CLUTCH HOUSING GM-6765783.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	CC	Outside diameter at bearing	4.724 to 4.7249	4.7236.
413	GG	Inside diameter of bearing	4.7236 to 4.7244	(*)
	CC-GG	Fit of housing in bearing	0.0013T to 0.0004L	0.0008L.

d. CONVERTER LOCK-UP CLUTCH PISTON GM-6763878.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	V	Outside diameter	12.985 to 12.990	12.982.
413	X	Inside diameter of bore in housing	13.000 to 13.005	13.008.
	V-X	Fit of piston in bore	0.010L to 0.020L	0.026L.
413	U	Inside diameter of piston	7.250 to 7.252	7.253.
413	BB	Outside diameter of seal ring hub on housing.	7.235 to 7.240	7.234.
	U-BB	Fit of piston on hub	0.010L to 0.017L	0.019L.

e. CONVERTER LOCK-UP CLUTCH PISTON DRIVE PIN GM-6762874.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	LL	Small outside diameter	0.3089 to 0.3094	
413	KK	Diameter of bore in housing	0.3075 to 0.3085	0.3088.
	LL-KK	Fit of pin in housing	0.0004T to 0.0019T	
413	MM	Large outside diameter	0.434 to 0.435	0.430.
413	NN	Diameter of bore in piston	0.4682 to 0.4692	0.4790.
	MM-NN	Fit of pin in piston	0.0332L to 0.0352L	

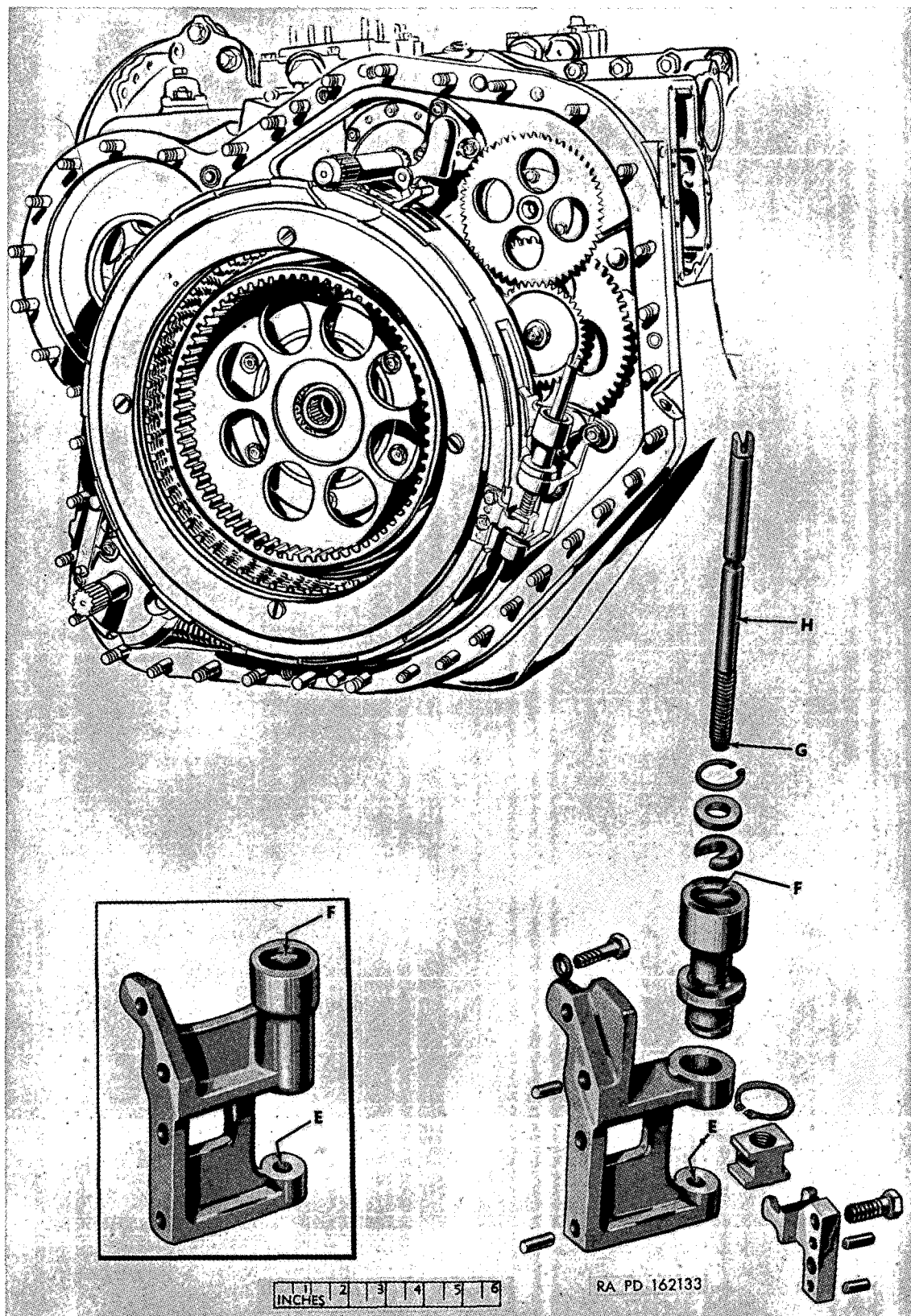
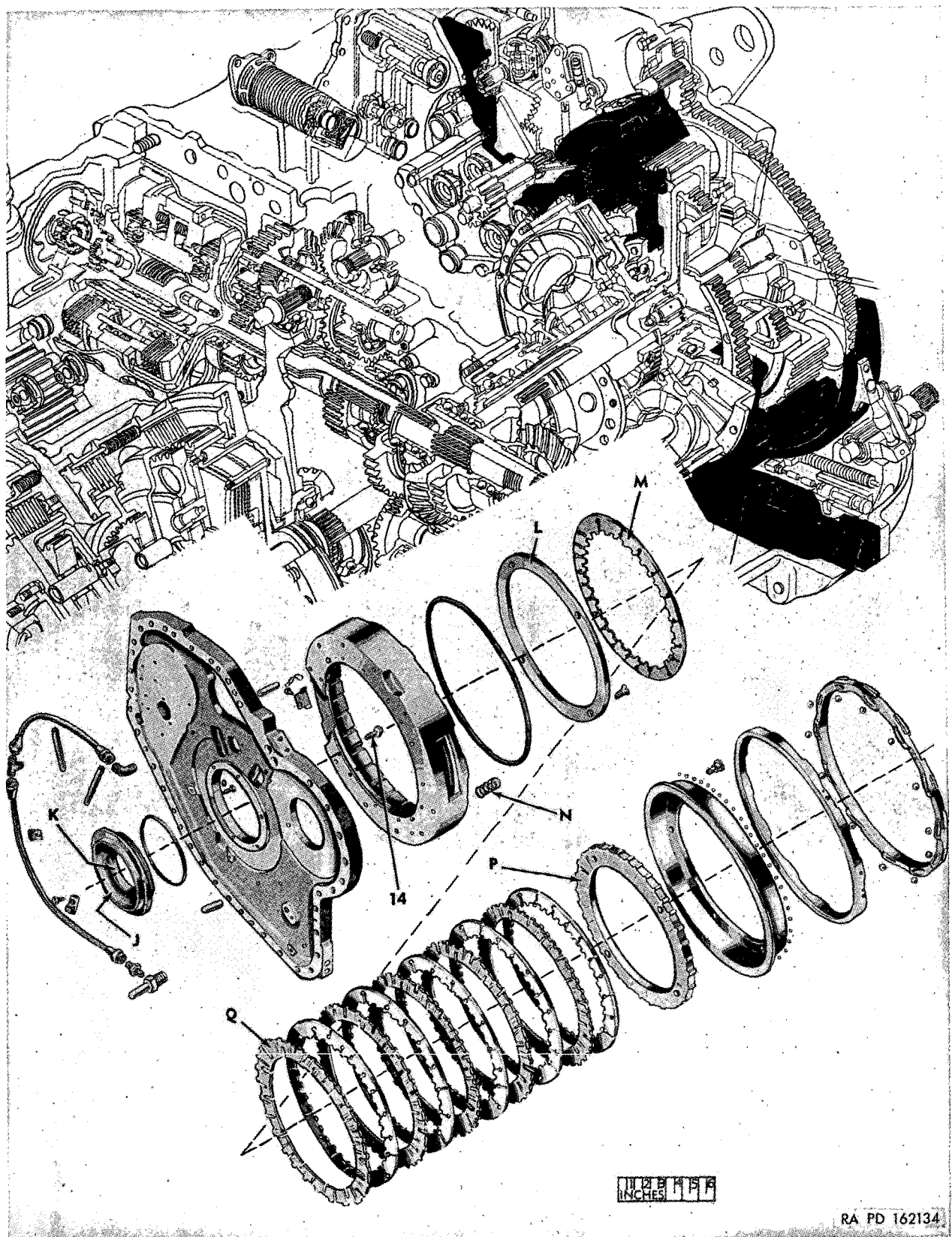
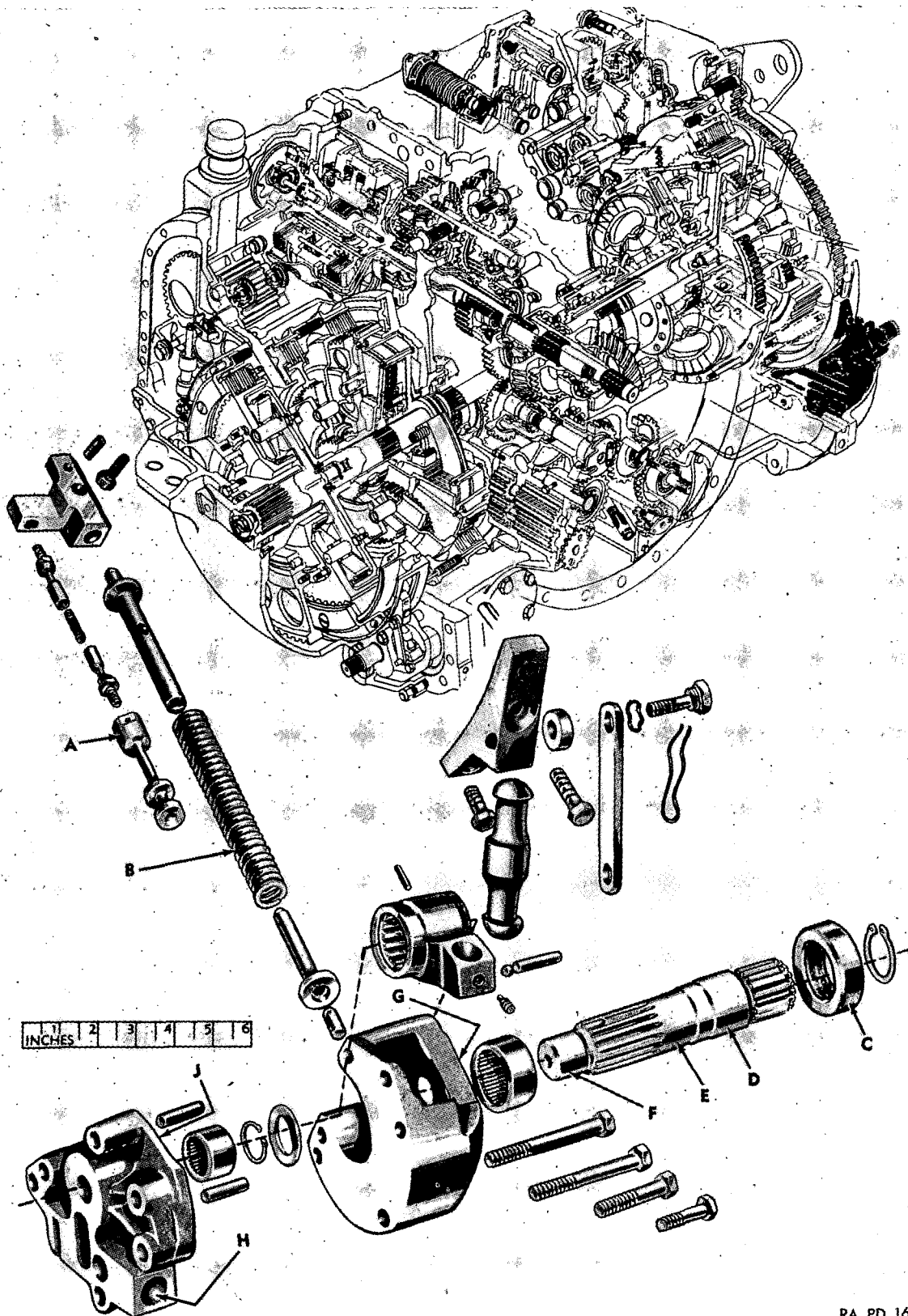


Figure 409. Serviceability standard points of measurement for left end plate.



RA PD 162134

Figure 410. Serviceability standard points of measurement for left end plate.



RA PD 162135

Figure 411. Serviceability standard points of measurement for left end plate.

f. CONVERTER LOCK-UP CLUTCH PLATE GM-6763776.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	PP	Thickness-----	0.158 to 0.163-----	0.138.

g. CONVERTER LOCK-UP CLUTCH MAIN PLATE GM-6763893.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	QQ	Outside diameter of hub-----	12.999 to 13.001-----	
413	X	Inside diameter of lock-up clutch piston housing.	13.000 to 13.005-----	
	QQ-X	Fit of hub in piston housing-----	0.001T to 0.006L-----	

h. CONVERTER PUMP GM-6765030.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	W	Outside diameter of pilot-----	13.310 to 13.312-----	
413	Q	Inside diameter of lock-up clutch main plate.	13.312 to 13.314-----	
	W-Q	Fit of pump in lock-up clutch main plate..	0.000 to 0.004L-----	

i. CONVERTER PUMP HUB GM-6765437.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	AA	Outside diameter-----	6.625 to 6.626-----	
413	T	Inside diameter of pump-----	6.626 to 6.628-----	
	AA-T	Fit of hub in pump-----	0.000 to 0.003L-----	

j. CONVERTER PUMP SEAL MATING RING GM-6765392.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	K	Inside diameter-----	4.252 to 4.256-----	4.257.
413	J	Outside diameter of shoulder on converter pump hub.	4.248 to 4.250-----	4.247.
	K-J	Fit of ring on converter pump hub-----	0.002L to 0.008L-----	

k. CONVERTER PUMP HUB SLEEVE GM-6765652.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	FF	Outside diameter-----	3.9985 to 4.000-----	3.9975.
413	Y	Inside diameter of pump hub-----	4.006 to 4.007-----	4.008.
	FF-Y	Fit of sleeve in hub-----	0.006L to 0.0085L-----	

l. CONVERTER GROUND SLEEVE GM-6763920.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	S	Outside diameter of ground sleeve-----	3.813 to 3.8135-----	3.8125.
413	DD	Inside diameter of pump hub sleeve-----	3.8155 to 3.8165-----	3.8175.
	S-DD	Fit of pump hub sleeve on ground sleeve.	0.002L to 0.0035L-----	

m. CONVERTER OIL TRANSFER SLEEVE GM-6760280.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	N	Outside diameter-----	3.191 to 3.192-----	
413	P	Inside diameter of ground sleeve-----	3.187 to 3.188-----	
	N-P	Fit of oil transfer sleeve in ground sleeve.	0.003T to 0.005T-----	

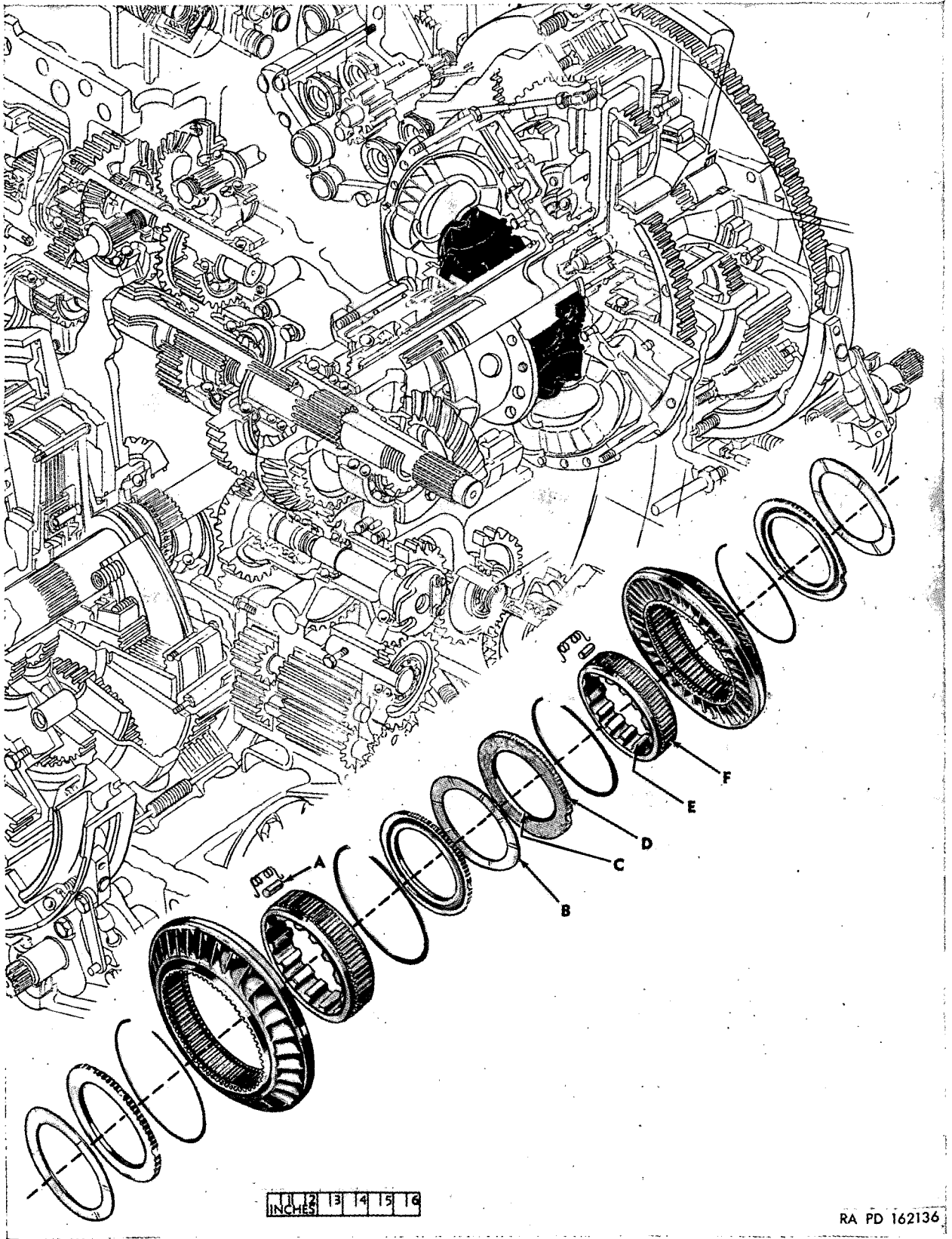
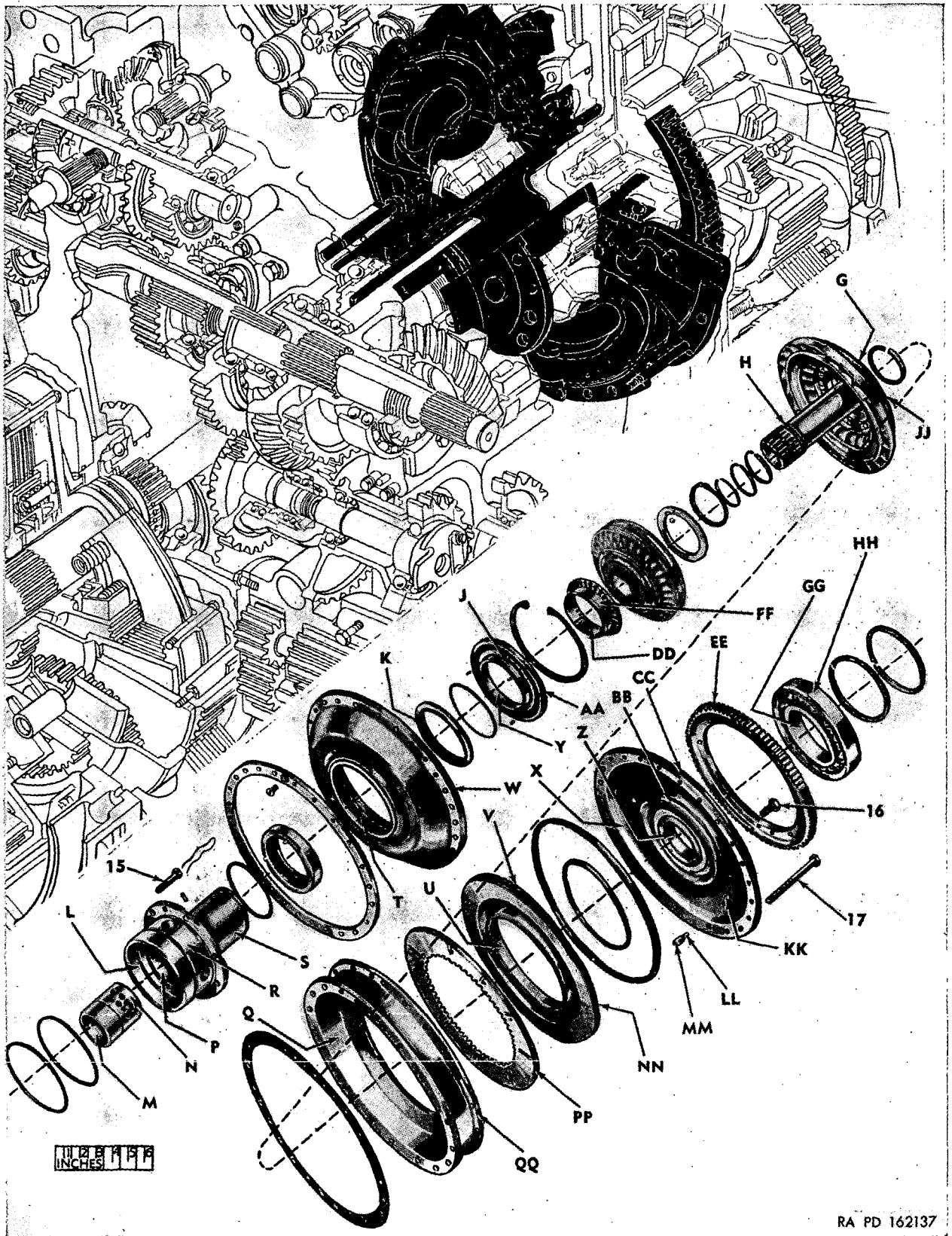


Figure 412. Serviceability standard points of measurement for torque converter.



RA PD 162137

Figure 413. Serviceability standard points of measurement for torque converter.

n. STATOR AND TURBINE SHAFT THRUST WASHERS GM-6760281.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
412	B	Thickness	0.061 to 0.063	0.057.

o. STATOR SPACER GM-6765654.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
412	D	Thickness	0.255 to 0.257	0.254.
412	C	Inside diameter	3.865 to 3.885	
413	S	Outside diameter of ground sleeve	3.813 to 3.8135	
	C-S	Fit of spacer on ground sleeve	0.0515L to 0.0072L	

p. CONVERTER TURBINE SHAFT GM-6763894.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	JJ	Outside diameter at lock-up clutch housing bushing.	3.1185 to 3.1195	3.1175.
413	Z	Inside diameter of bushing	3.1237 to 3.1257	3.1267.
	JJ-Z	Fit of shaft in bushing	0.0042L to 0.0072L	
413	H	Outside diameter of shaft at converter oil transfer sleeve.	2.970 to 2.975	
413	M	Inside diameter of sleeve	3.000	
	H-M	Fit of shaft in converter oil transfer sleeve.	0.025L to 0.030L	

q. CONVERTER OUTPUT BEVEL GEAR SHAFT BEARING GM-903018.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	SS	Outside diameter	5.5110 to 5.5118	5.5105.
413	L	Inside diameter of ground sleeve	5.5116 to 5.5126	5.5136.
	SS-L	Fit of bearing in ground sleeve	0.0002T to 0.0016L	0.0026L.

r. FREEWHEEL ROLLER GM-6765648.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
412	A	Outside diameter	0.3748 to 0.3750	0.3746.

s. STATOR CAM GM-6765653.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
412	F	Thickness	1.028 to 0.030	1.027.
412	E	Inside diameter	3.816 to 3.817	3.818.
413	S	Outside diameter of ground sleeve	3.813 to 3.8135	3.8125.
	E-S	Fit of stator cam on ground sleeve	0.0025L to 0.004L	

99. Right End Cover

(Par. 46)

Note. The serviceability standards given for the left end cover (par. 96) may be used to obtain any fits and clearances for the right end cover.

100. Right End Plate and Drive Clutch Package Unit

(Par. 50)

Note. Serviceability standards' information which may be needed for the brake assembly on the right end plate may be obtained by checking the comparable parts in the left brake assembly (par. 97).

a. LOW-RANGE CLUTCH PISTON GM-6765449.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	H	Outside diameter.....	17.605 to 17.610.....	17.603.
414	B	Inside diameter of bore in end plate.....	17.625 to 17.630.....	17.632.
	H-B	Fit of piston in end plate.....	0.015L to 0.025L.....	0.029L.
414	G	Inside diameter.....	12.378 to 12.383.....	12.385.
414	C	Outside diameter of piston hub in end plate.....	12.369 to 12.373.....	12.367.
	G-C	Fit of piston on hub.....	0.005L to 0.014L.....	

b. HIGH-RANGE CLUTCH TRANSFER OIL TUBE GM-6765369.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	F	Outside diameter at end plate and reverse clutch housing.....	0.4959 to 0.4964.....	(*).
414	D	Inside diameter of bore in end plate.....	0.4944 to 0.4954.....	0.4957.
416	L	Inside diameter of bore in reverse clutch housing.....	0.4939 to 0.4954.....	0.4958.
	F-D	Fit of tube in end plate bore.....	0.0005T to 0.0020T.....	
	F-L	Fit of tube in reverse clutch housing.....	0.0005T to 0.0025T.....	

c. REVERSE-RANGE CLUTCH TRANSFER OIL TUBE GM-6760053.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	E	Outside diameter at end plate and reverse clutch housing.....	0.4336 to 0.4341.....	
414	A	Inside diameter of bore in end plate.....	0.4321 to 0.4331.....	0.4334.
416	M	Inside diameter of bore in reverse-range housing.....	0.4321 to 0.4331.....	0.4334.
	E-A	Fit of tube in end plate bore.....	0.0005T to 0.0020T.....	
	E-M	Fit of tube in reverse-range clutch housing bore.....	0.0005T to 0.0020T.....	

d. LOW- AND REVERSE-RANGE CLUTCH EXTERNAL SPLINED SINGLE FACED DISK GM-6763898.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	N	Thickness.....	0.122 to 0.127.....	0.112.

e. LOW- AND REVERSE-RANGE CLUTCH DISK GM-6704122.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	M	Cone.....	0.015 to 0.021.....	0.005 to 0.023.

f. LOW- AND REVERSE-RANGE CLUTCH EXTERNAL SPLINED DOUBLE FACED DISK GM-6763906.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	L	Thickness.....	0.158 to 0.163.....	0.138.

g. LOW-RANGE RING GEAR GM-6760079.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	K	Backlash with low-range pinions on standard centers.....	0.004 to 0.010.....	

h. REVERSE-RANGE RING GEAR GM-6763718.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	R	Backlash with reverse-range pinions on standard centers.....	0.004 to 0.009.....	

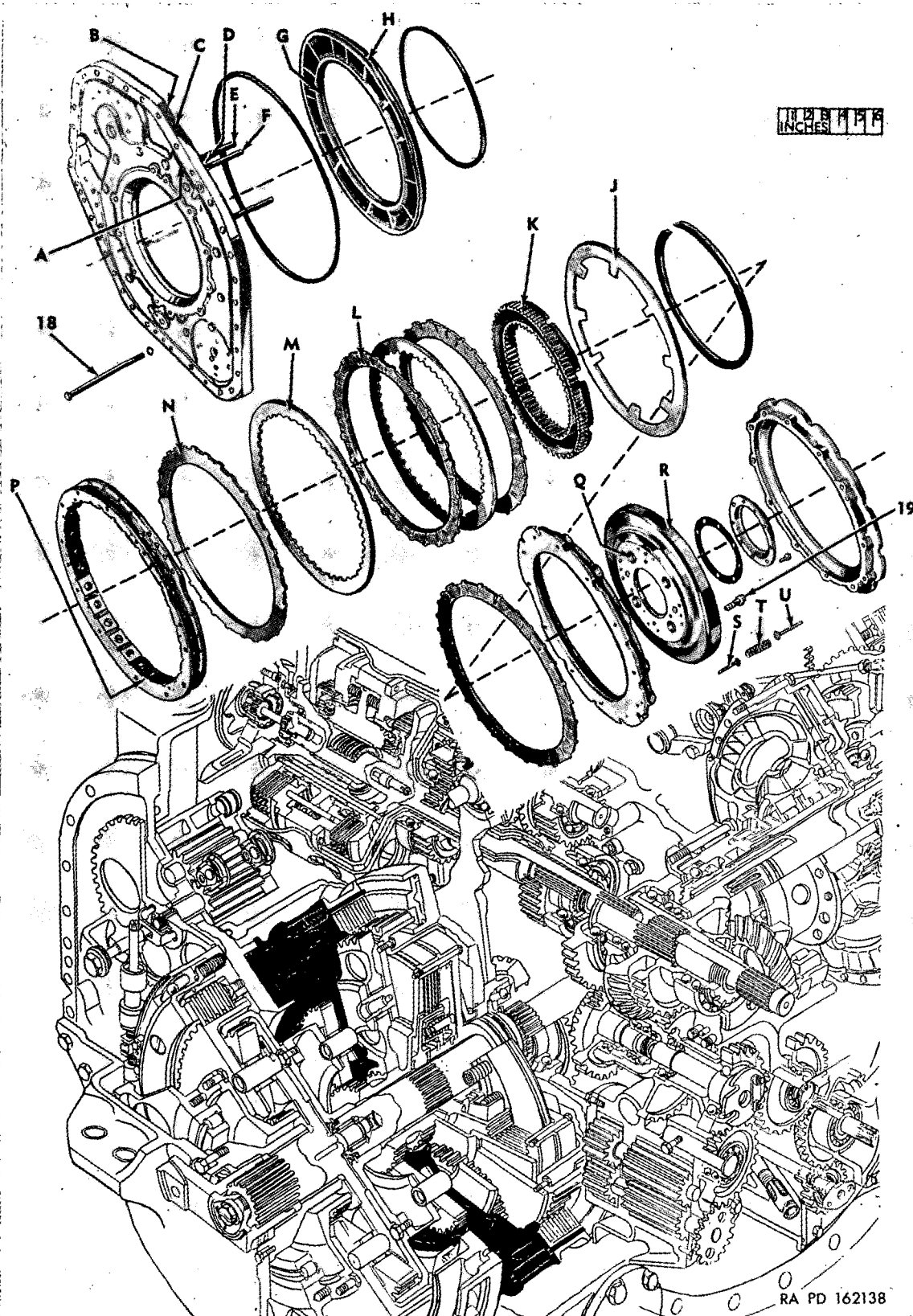


Figure 414. Serviceability standard points of measurement for right end plate and drive clutch package unit.

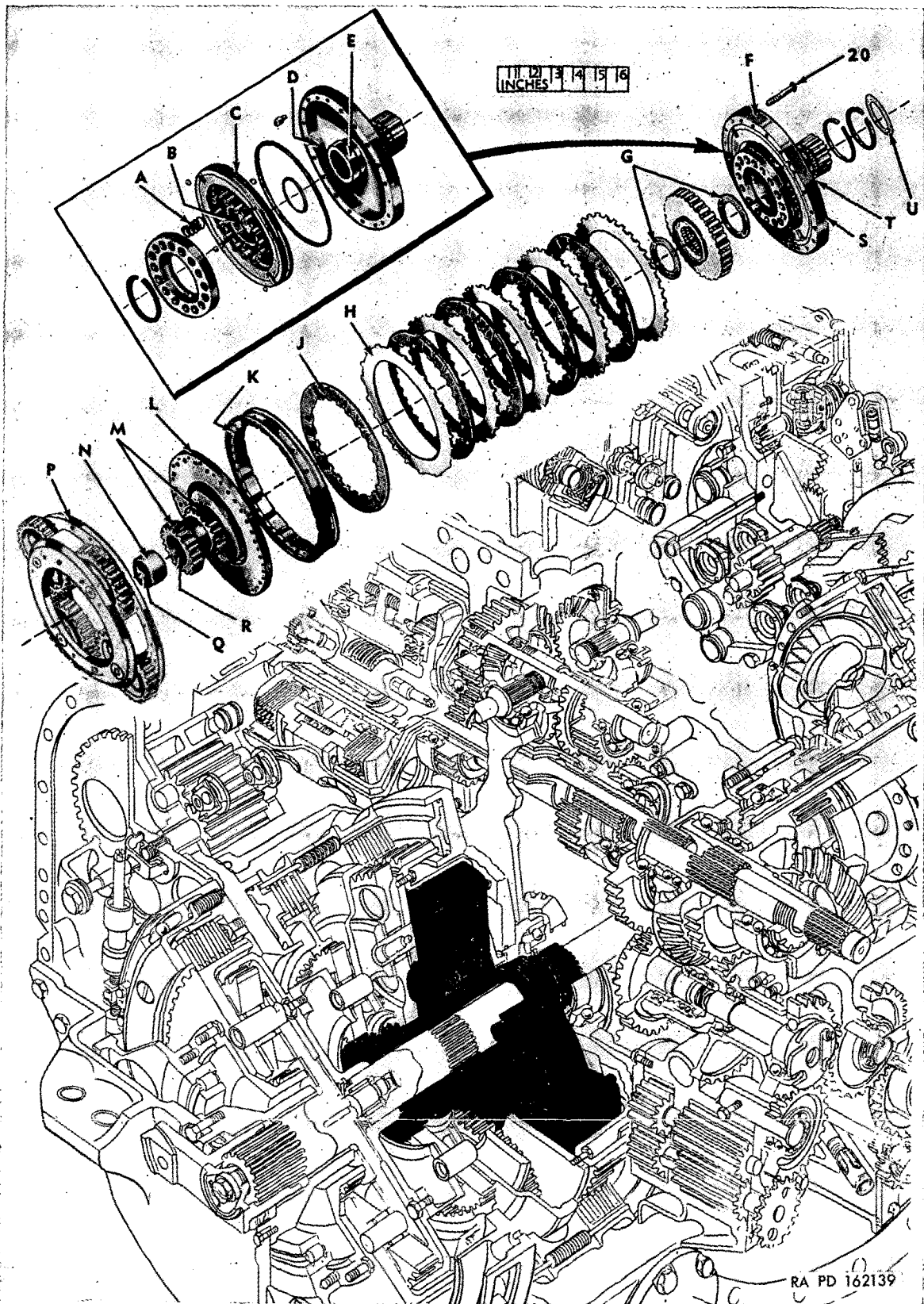


Figure 415. Serviceability standard points of measurement for right end plate and drive clutch package unit.

i. LOW-RANGE CLUTCH RETURN PIN GM-6760064.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	S	Outside diameter.....	0.179 to 0.181.....	0.177.
414	P	Diameter of the bore in low-range clutch ring.	0.201 to 0.203.....	0.205.
	S-P	Fit of pin in ring.....	0.020L to 0.024L.....	

j. LOW- AND REVERSE-RANGE CLUTCH PISTON RETURN SPRING GM-8605911.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	T	Free height.....	2.258.....	
414	T	Height under 58 to 64 lb load.....	1.728.....	1.650.

k. PISTON RETURN PIN GM-6760065.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	U	Outside diameter.....	0.179 to 0.181.....	0.178.
416	H	Diameter of bore in reverse-range clutch ring.	0.186 to 0.188.....	0.189.
	U-H	Fit of pin in ring.....	0.005L to 0.009L.....	0.011L.

l. HIGH-RANGE CLUTCH HOUSING GM-6763723.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	T	Outside diameter at reverse-range clutch housing hub.	3.350 to 3.365.....	3.348.
416	N	Inside diameter of hub.....	3.375 to 3.377.....	3.379.
	T-N	Fit of housing in hub.....	0.010L to 0.027L.....	0.031L.
415	S	Outside diameter at reverse-range clutch hub bushing.	3.493 to 3.497.....	3.492.
416	S	Inside diameter of bushing.....	3.4995 to 3.5005.....	3.502.
	S-S	Fit of housing in bushing.....	0.0025L to 0.0075L.....	0.010L.

m. REVERSE- AND HIGH-RANGE HOUSINGS THRUST WASHERS GM-6763708.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts.	Wear limits
416	A	Thickness.....	0.061 to 0.063.....	0.057.
415	U	Thickness.....	0.061 to 0.063.....	0.057.

n. HIGH-RANGE CLUTCH PISTON ASSEMBLY GM-6765567.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	C	Outside diameter.....	9.730 to 9.735.....	9.728.
415	D	Inside diameter of bore in high-range clutch housing.	9.750 to 9.755.....	9.748.
	C-D	Fit of piston in housing.....	0.015L to 0.025L.....	
415	B	Inside diameter.....	3.125 to 3.130.....	3.137.
415	E	Outside diameter of bore in high-range clutch housing.	3.119 to 3.123.....	3.118.
	B-E	Fit of piston in housing.....	0.002L to 0.011L.....	

o. HIGH-RANGE CLUTCH PINION GM-6763721.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	M	Backlash or low- and reverse-range sun gears with their respective mating gears on standard centers.	0.004 to 0.009.....	

p. HIGH-RANGE CLUTCH PINION BUSHING GM-6760066.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	N	Outside diameter.....	0.004 to 0.007 press fit..	0.003.
415	R	Diameter of bore in high-range clutch pinion.	2.3745 to 2.3755.....	
415	Q	Inside diameter of bushing.....	2.2495 to 2.2505.....	2.2525.
407	K	Outside diameter of cross-drive shaft at bushing.	2.247 to 2.248.....	2.246.
	K-Q	Fit of shaft in bushing.....	0.0015L to 0.0035L.....	0.0060L.

q. HIGH-RANGE CLUTCH PINION AND INNER DRIVE HUB THRUST WASHER GM-6760060.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	G	Thickness.....	0.093 to 0.095.....	0.089.

r. HIGH-RANGE CLUTCH OUTER DRIVE RING GM-6763797.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	K	Inside diameter of pilots.....	11.000 to 11.002.....	11.003.
415	F	Outside diameter of high range clutch housing.	10.9985 to 10.9995.....	10.9980.
	K-F	Fit of ring on housing.....	0.0005L to 0.0035L.....	0.0045L.
415	L	Outside diameter of high-range clutch pinion.	10.9985 to 10.9995.....	10.9980.
	K-L	Fit of ring on pinion.....	0.0005L to 0.0035L.....	0.0045L

s. HIGH-RANGE CLUTCH PISTON RETURN SPRING GM-6763922.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	A	Free height.....	1.361.....	
415	A	Height under 48.7 to 58.7 lb load.....	1.156.....	43.7 lb at 1.156.

t. HIGH-RANGE CLUTCH DISK (BRONZE) GM-6765350.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	J	Thickness.....	0.090 to 0.096.....	0.070.

u. HIGH-RANGE CLUTCH DISK (STEEL) GM-6763841.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
415	H	Cone.....	0.012 to 0.021.....	0.008 to 0.024.

v. REVERSE-RANGE CLUTCH HUB GM-6763706.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
416	C	Inside diameter of reverse-range clutch hub pilot.	13.125 to 13.127.....	13.128.
415	P	Outside diameter of carrier.....	13.125 to 13.127.....	13.124.
	C-P	Fit of hub on carrier.....	0.002T to 0.002L.....	0.004L.

w. REVERSE-RANGE CLUTCH HUB BUSHING GM-6760063.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
416	G	Outside diameter.....	0.006 to 0.009 press fit..	0.005.
416	D	Diameter of bore in reverse-range clutch hub.	3.687 to 3.688.....	

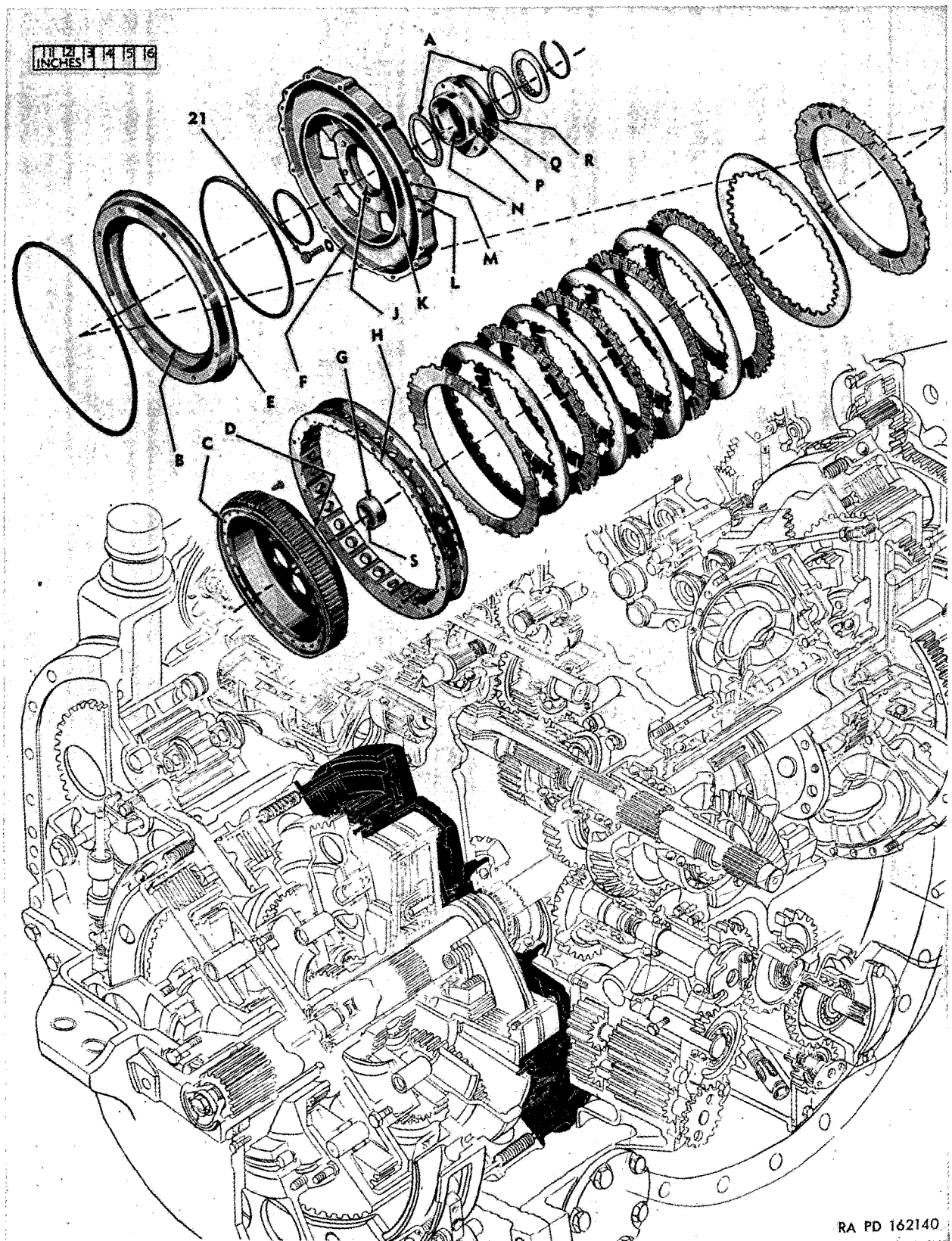


Figure 416. Serviceability standard points of measurement for right end plate and drive clutch package unit.

x. REVERSE-RANGE PLANET PINION SPINDLE GM-6763909.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	LL	Outside diameter.....	1.1299 to 1.1302.....	1.1298.
407	NN	Diameter of bore in carrier and plate.....	1.1297.....	1.1298.
	LL-NN	Fit of spindle in carrier and plate.....	0.0002T to 0.0005T.....	0.00015T.

y. REVERSE-RANGE PLANET PINION BEARING SPACER GM-6704429.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	JJ	Thickness.....	0.061 to 0.063.....	0.060.
407	Y	Inside diameter.....	1.132 to 1.134.....	1.135.
	Y-LL	Fit of spacer on spindle.....	0.0018L to 0.0041L.....	0.0061L.

z. REVERSE-RANGE PLANET PINION THRUST WASHER GM-6704428.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	KK	Thickness.....	0.061 to 0.063.....	0.057.
407	X	Inside diameter.....	1.505 to 1.507.....	1.508.
407	HH	Outside diameter of spacer.....	1.502 to 1.504.....	1.501.
	X-HH	Fit of washer on spacer.....	0.001L to 0.005L.....	0.006L.

aa. REVERSE-RANGE PLANET PINION BEARING (ROLLERS) GM-6704426.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	EE	Outside diameter.....	0.1873 to 0.1875.....	(*)

ab. REVERSE-RANGE PLANET PINION GM-6763702.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	FF	Inside diameter.....	1.5057 to 1.5062.....	1.5065.
407	Z	Backlash with mating gear on standard centers.	0.004 to 0.009.....	

ac. REVERSE-RANGE CLUTCH HOUSING HUB GM-6763704.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
416	Q	Outside diameter.....	6.373 to 6.374.....	6.372.
420	K	Inside diameter of bore in right housing.....	6.3745 to 6.3755.....	6.3765.
	Q-K	Fit of hub in right housing.....	0.0005L to 0.0025L.....	0.0045L.
416	P	Outside diameter at reverse-range clutch housing.	4.748 to 4.749.....	4.747.
416	J	Inside diameter of bore in housing.....	4.750 to 4.751.....	
	P-J	Fit of hub in housing.....	0.001L to 0.003L.....	0.005L.
416	R	Bore at converter output shaft bearing.....	5.5116 to 4.5126.....	5.513.
419	TT	Outside diameter of bearing.....	5.5110 to 5.5118.....	5.5105.
	R-TT	Fit of bearing in bore.....	0.0002T to 0.0016L.....	0.0025L.

ad. REVERSE-RANGE CLUTCH PISTON GM-6765449.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
416	E	Outside diameter.....	17.605 to 17.610.....	17.603.
416	F	Inside diameter of bore in reverse-range clutch housing.	17.625 to 17.630.....	17.632.
	E-F	Fit of piston in housing.....	0.015L to 0.025L.....	0.029L.
416	B	Inside diameter.....	12.378 to 12.383.....	12.385.
416	K	Outside diameter of bore in reverse-range clutch housing.	12.369 to 12.373.....	12.367.
	B-K	Fit of piston in housing.....	0.005L to 0.014L.....	0.019L.

ae. LOW-RANGE RING GEAR DISK GM-6760038.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
414	J	Thickness	0.122 to 0.126	
414	J	Cone	0.021 to 0.027	0.016 to 0.030, two per clutch at 0.030.

af. LOW-RANGE PLANET PINION SPINDLE GM-6763909.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	LL	Outside diameter	1.1299 to 1.1302	1.1298.
407	DD	Diameter of bore in carrier	1.1297	1.1298.
	LL-DD	Fit of spindle in carrier	0.0002T to 0.0005T	0.00015T.
414	Q	Diameter of bore in reverse ring gear	1.1297	1.1298.
	LL-Q	Fit of spindle in ring gear	0.0002T to 0.0005T	0.00015T.

ag. LOW-RANGE PLANET PINION BEARING SPACER GM-6704429.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	JJ	Thickness	0.061 to 0.063	0.060.
407	Y	Inside diameter	1.132 to 1.134	1.135.
	Y-LL	Fit of spacer on spindle	0.0018L to 0.0041L	0.0061L.

ah. LOW-RANGE PLANET PINION THRUST WASHER GM-6704428.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	KK	Thickness	0.061 to 0.063	0.057.
407	X	Inside diameter	1.505 to 1.507	1.508.
407	HH	Outside diameter of spacer	1.502 to 1.504	1.501.
	X-HH	Fit of washer on spacer	0.001L to 0.005L	0.006L.

ai. LOW-RANGE PLANET PINION BEARING (ROLLER) GM-6704426.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	EE	Outside diameter	0.1873 to 0.1875	(*).

aj. LOW-RANGE PLANET PINION GM-6704431.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	GG	Inside diameter	1.5057 to 1.5062	1.5065.
407	MM	Backlash with mating gear on standard centers.	0.004 to 0.009	

ak. LOW-RANGE PLANET CARRIER GM-6765279.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	AA	Inside diameter of pilot	9.251 to 9.253	9.254.
407	BB	Outside diameter of right output ring gear hub.	9.248 to 9.250	9.247.
	AA-BB	Fit of carrier on hub	0.001L to 0.005L	0.007L.

al. RIGHT OUTPUT RING GEAR GM-6765278.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
407	CC	Backlash with output planet pinions on standard centers.	0.006 to 0.012	

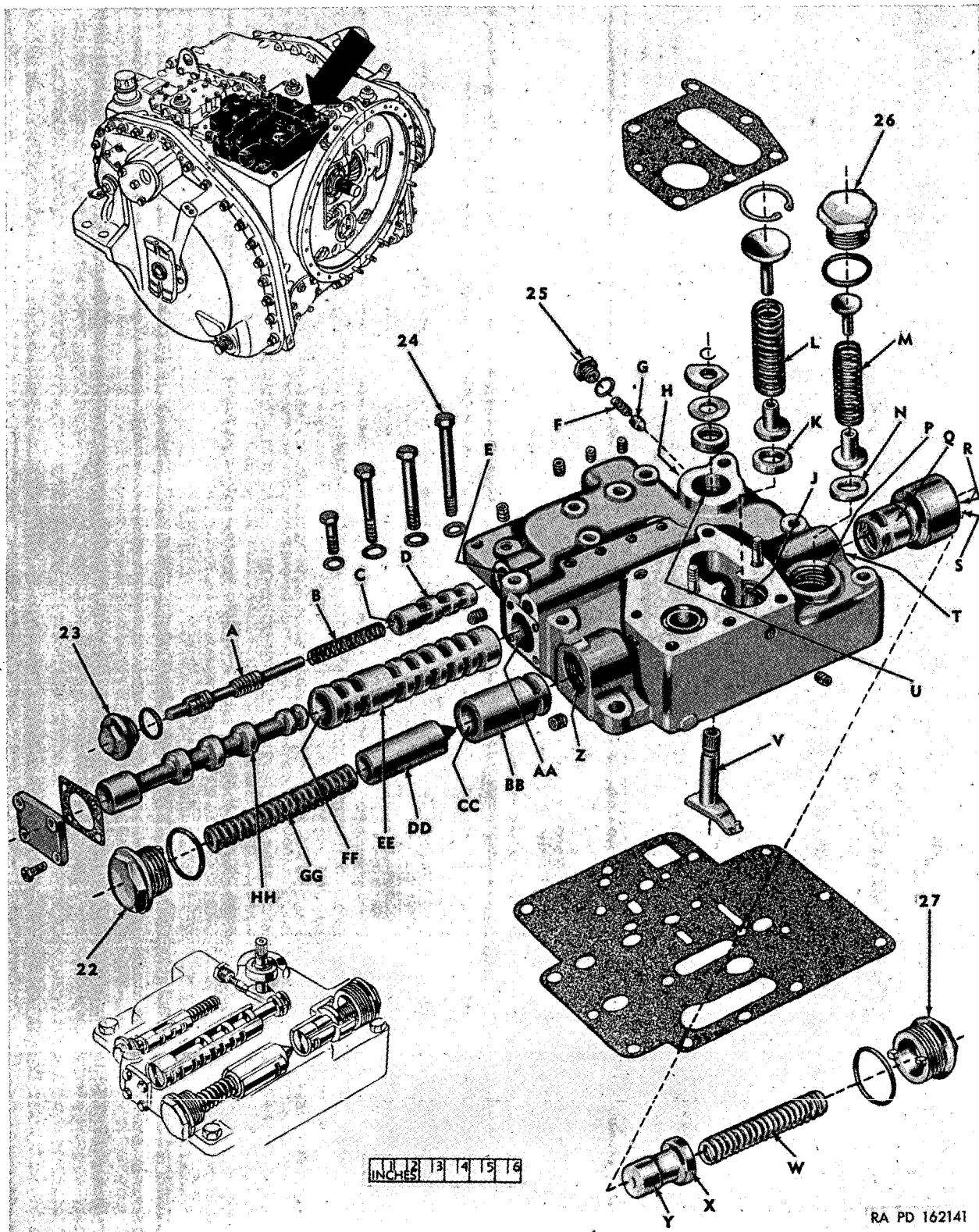


Figure 417. Serviceability standard points of measurement for control valve bodies.

101. Control Valve Bodies

(Par. 54)

a. OVER SPEED SAFETY VALVE SPRING GM-6765419.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	B	Free height.....	2.914.....	
417	B	Height under 14.4 to 17.6 lb load.....	2.00.....	13.6 lb at 2.00.

b. OVER SPEED SAFETY VALVE GM-6765436.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	A	Outside diameter.....	0.6235 to 0.624.....	0.6230.
417	C	Over speed safety valve bore in sleeve.....	0.6245 to 0.6255.....	0.6265.
	A-C	Fit of valve in sleeve.....	0.0005L to 0.002L.....	0.0025L.

c. OVER SPEED SAFETY VALVE SLEEVE GM-6765424.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	D	Outside diameter.....	0.8750 to 0.8755.....	0.8745.
417	E	Diameter of bore in valve body.....	0.8745 to 0.8755.....	0.8765.
	D-E	Fit of sleeve in bore.....	0.0005L to 0.001T.....	0.001L.

d. RANGE SELECTOR VALVE GM-6760107.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	HH	Outside diameter.....	1.1235 to 1.124.....	1.1230.
417	FF	Range selector valve bore in sleeve.....	1.1245 to 1.1255.....	1.1265.
	HH-FF	Fit of valve in sleeve.....	0.0005L to 0.002L.....	0.0025L.

e. RANGE SELECTOR VALVE SLEEVE GM-6764143.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	EE	Outside diameter.....	1.374 to 1.3745.....	1.3735.
417	AA	Diameter of bore in valve body.....	1.3745 to 1.3755.....	1.376.
	EE-AA	Fit of sleeve in bore.....	0.0015L to 0.000.....	0.0025L.

f. MAIN OIL PRESSURE REGULATOR SPRING GM-6764513.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	GG	Free height.....	5.0.....	
417	GG	Height under 134 to 164 lb load.....	3.906.....	132 lb at 3.906.

g. MAIN OIL PRESSURE REGULATOR VALVE GM-6760114.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	DD	Outside diameter.....	1.1235 to 1.124.....	1.1230.
417	CC	Main pressure regulator bore in sleeve.....	1.1245 to 1.1255.....	1.1265.
	DD-CC	Fit of valve in sleeve.....	0.0005L to 0.002L.....	0.0025L.

h. MAIN OIL PRESSURE REGULATOR SLEEVE GM-6764136.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	BB	Outside diameter.....	1.374 to 1.3745.....	1.3735.
417	Z	Diameter of bore in valve body.....	1.3745 to 1.3755.....	1.3765.
	BB-Z	Fit of sleeve in bore.....	0.0015L to 0.000.....	0.0025L.

i. CONVERTER REGULATOR VALVE SPRING GM-6765451.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	W	Free height.....	5.394.....	
417	W	Height under 72.5 to 88.5 lb load.....	3.844.....	71 lb at 3.844.

j. CONVERTER PRESSURE REGULATOR VALVE GM-6764135.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	Y	Outside diameter actuating end (1).....	1.1235 to 1.124.....	1.1230.
417	X	Outside diameter valve end (2).....	1.6235 to 1.624.....	1.6230.
417	R	Converter pressure regulator bore in sleeve (1).	1.1245 to 1.1255.....	1.1265.
417	S	Converter pressure regulator bore in sleeve (2).	1.6245 to 1.6255.....	1.6265.
	Y-R	Fit of valve in sleeve (1).....	0.0005L to 0.002L.....	0.0025L.
	X-S	Fit of valve on sleeve (2).....	0.0005L to 0.002L.....	0.0025L.

k. CONVERTER PRESSURE REGULATOR SLEEVE GM-6764138.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	Q	Outside diameter.....	1.374 to 1.3745.....	1.3735.
417	T	Diameter of bore in valve body.....	1.3745 to 1.3755.....	1.3765.
	Q-T	Fit of sleeve in bore.....	0.0015L to 0.000.....	0.0025L.

l. COOLER BY-PASS SPRING GM-6764517.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	L	Free height.....	3.062.....	
417	L	Height under 56.8 to 68.8 lb load.....	2.062.....	53.8 lb at 2.062.

m. COOLER BY-PASS VALVE SEAT GM-6764118.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	K	Outside diameter.....	1.251 to 1.2515.....	(*)
417	J	Diameter of spotface in valve body.....	1.2495 to 1.2505.....	
	K-J	Fit of seat in spotface.....	0.0005T to 0.002T.....	

n. LUBRICATION PRESSURE REGULATOR VALVE SPRING GM-5764516.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	M	Free height.....	2.808.....	
417	M	Height under 21.6 to 25.6 lb load.....	1.437.....	20.6 lb at 1.437.

o. PRESSURE REGULATOR VALVE SEAT GM-6764118.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	N	Outside diameter.....	1.251 to 1.2515.....	(*)
417	P	Diameter of spotface in valve body.....	1.2495 to 1.2505.....	
	N-P	Fit of seat in spotface.....	0.0005T to 0.002T.....	

p. SHIFT CONTROL LEVER SHAFT GM-6760050.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	V	Outside diameter.....	0.6235 to 0.624.....	0.6225.
417	U	Diameter of bore.....	0.6245 to 0.6255.....	0.626.
	V-U	Fit of shaft in bore.....	0.0005L to 0.002L.....	0.003L.

q. SHIFT LEVER POPPET SPRING GM-6704182.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	F	Free height-----	1-----	
417	F	Height under 11.05 to 13.45 lb load-----	0.656-----	10 lb at 0.656.

r. SHIFT LEVER POPPET GM-6700687.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
417	G	Outside diameter-----	0.435 to 0.436-----	0.434.
417	H	Diameter of bore in valve body-----	0.437 to 0.438-----	0.439.
	G-H	Fit of poppet in bore-----	0.001L to 0.003L-----	0.005L.

s. STEERING VALVE SPRING GM-6765614.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
418	C	Free height-----	2.102-----	
418	C	Height under 130.5 to 159.5 lb load-----	1.639-----	112.5 lb at 1.639.

t. STEERING VALVE GM-6765445.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
418	A	Large outside diameter-----	1.359 to 1.3595-----	1.3585.
418	B	Small outside diameter-----	0.998 to 0.9985-----	0.9975.
418	D	Diameter of large bore in valve body-----	1.3605 to 1.3615-----	1.3625.
418	E	Diameter of small bore in valve body-----	0.9995 to 1.0005-----	1.0015.
	A-D	Fit of valve in large bore-----	0.001L to 0.0025L-----	0.003L.
	B-E	Fit of valve in small bore-----	0.001L to 0.0025L-----	0.003L.

u. STEERING LEVER SHAFT GM-6765616.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
418	G	Outside diameter-----	0.6235 to 0.624-----	0.6225.
418	F	Diameter of bore-----	0.6245 to 0.6255-----	0.626.
	G-F	Fit of shaft in bore-----	0.0005L to 0.002L-----	0.003L.

v. SHAFT DETENT SPRING GM-6704182.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
418	H	Free height-----	1-----	
418	H	Height under 11.05 to 13.45 lb load-----	0.656-----	10 lb at 0.656.

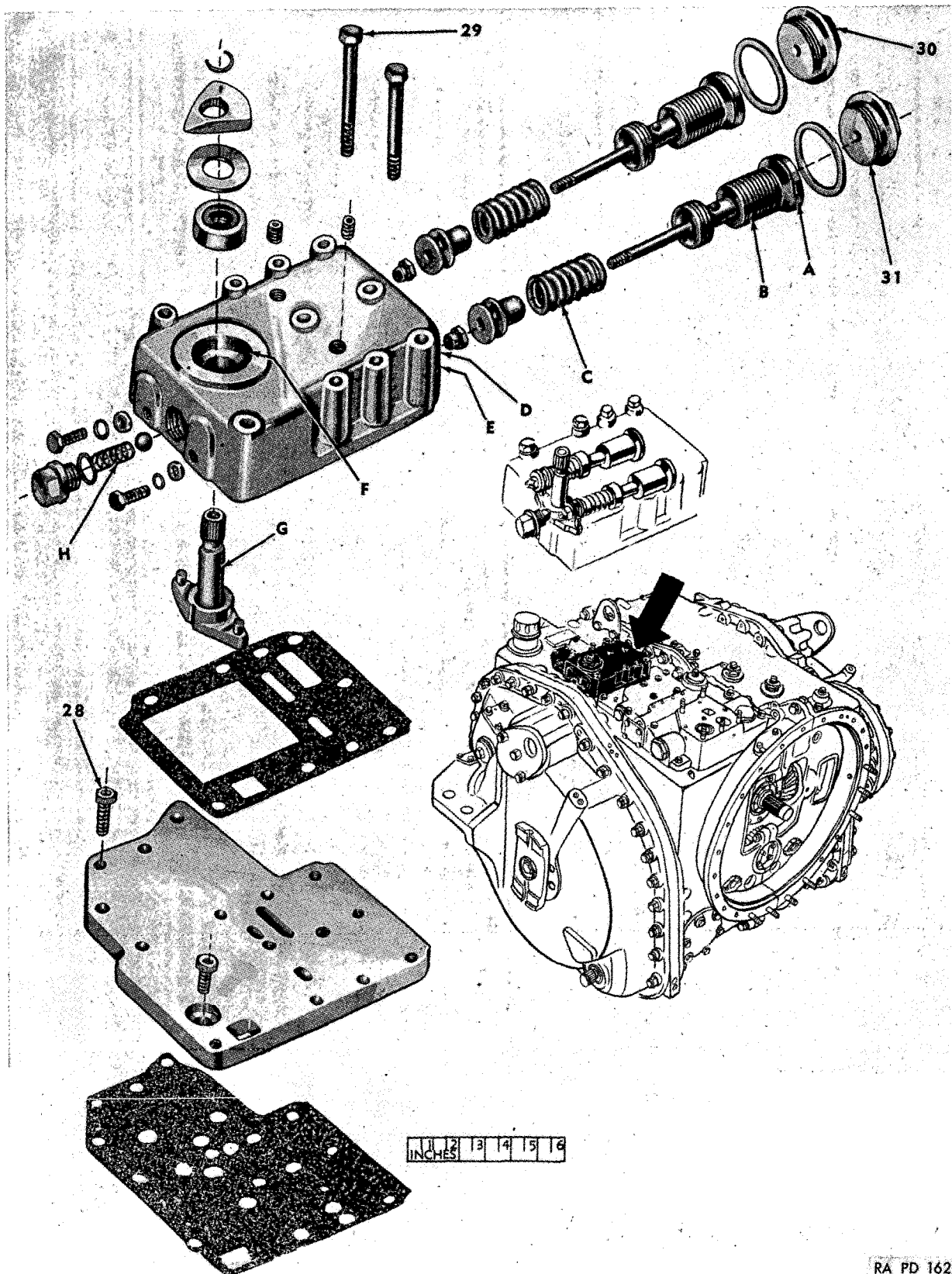
102. Left Housing (Par. 58)

a. INPUT BEVEL PINION BEARING CAGE GM-6760131.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	BB	Outside diameter-----	4.6235 to 4.6245-----	4.6225.
419	AA	Diameter of bore in support-----	4.6245 to 4.6255-----	4.6265.
	BB-AA	Fit of cage in support-----	0.000 to 0.002L-----	0.003L.

b. INPUT SHAFT FRONT BEARING GM-905212.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	DD	Outside diameter-----	4.3301 to 4.3307-----	4.3296.
419	CC	Inside diameter of cage-----	4.3306 to 4.3314-----	4.3319.
	DD-CC	Fit of bearing in cage-----	0.0001T to 0.0013L-----	0.0023L.



RA PD 162142

Figure 418. Serviceability standard points of measurement for control valve bodies.

c. INPUT BEVEL PINION BEARING RETAINER GM-6760099.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	FF	Outside diameter of shoulder-----	4.325 to 4.330-----	4.323.
419	CC	Inside diameter of cage-----	4.3306 to 4.3314-----	4.3319.
	FF-CC	Fit of retainer in cage-----	0.0006L to 0.0064L-----	0.0069L.

d. INPUT SHAFT CENTER BEARING GM-905014.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	H	Outside diameter-----	4.3301 to 4.3307-----	4.3296.
419	K	Diameter of bore in center bearing support.	4.3306 to 4.3314-----	4.3319.
	H-K	Fit of bearing in support-----	0.0001T to 0.0013L-----	0.0023L.

e. INPUT SHAFT GM-6764959.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	D	Outside diameter at input bevel pinion bearing.	2.3622 to 2.3627-----	2.3620.
419	EE	Inside diameter of bearing-----	2.3616 to 2.3622-----	(*).
	D-EE	Fit of shaft in bearing-----	0.0011T to 0.000-----	0.0002L.
419	C	Outside diameter at rear-----	2.7554 to 2.7560-----	2.7551.
419	J	Inside diameter of center bearing-----	2.7553 to 2.7559-----	2.7562.
	C-J	Fit of shaft in bearing-----	0.0007T to 0.0005L-----	0.0011L.
419	G	Inside diameter of spacer-----	2.758 to 2.768-----	2.773.
	C-G	Fit of shaft in spacer-----	0.002L to 0.0126L-----	
419	F	Inside diameter of output shaft rear bearing.	2.7553 to 2.7559-----	2.7564.
	C-F	Fit of shaft in bearing-----	0.0007T to 0.0005L-----	0.0013L.

f. FAN DRIVE GEAR GM-6760134.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	Z	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

g. INPUT DRIVING BEVEL GEAR GM-6704178.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	L	Refer to paragraph 59l for backlash-----	-----	

h. INPUT DRIVEN BEVEL GEAR GM-6764199.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	N	Outside diameter at input driven bevel gear bearing.	2.5656 to 2.5662-----	2.5646.
419	Q	Inside diameter of bearing-----	2.5666 to 2.5670-----	
	N-Q	Fit of gear in bearing-----	0.0004L to 0.0014L-----	
419	P	Outside diameter at converter drive spur gear bearing.	1.9684 to 1.9689-----	1.9682.
419	U	Inside diameter of bearing-----	1.9680 to 1.9685-----	(*).
	P-U	Fit of gear in bearing-----	0.0009T to 0.0001L-----	0.003L.
419	M	Refer to paragraph 59l for backlash-----	-----	

i. CONVERTER DRIVE GEAR BEARING INNER CAGE GM-6764195.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	S	Outside diameter-----	4.6235 to 4.6245-----	
420	F	Diameter of bore in left housing-----	4.6245 to 4.6255-----	4.6265.
	S-F	Fit of cage in bore-----	0.000 to 0.002L-----	

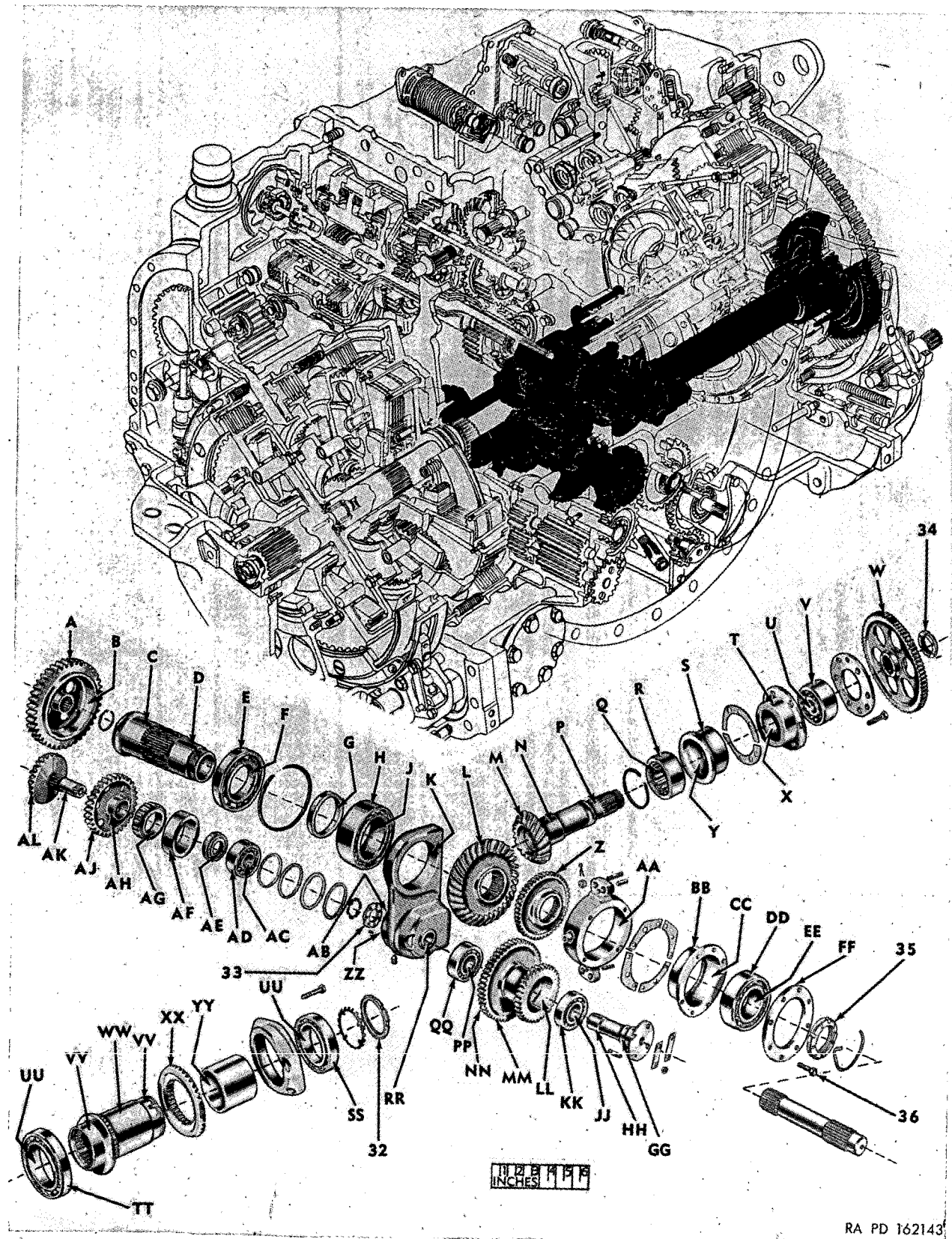


Figure 419. Serviceability standard points of measurement for left housing.

j. INPUT DRIVEN BEVEL GEAR BEARING GM-7450191.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	R	Outside diameter-----	4.3301 to 4.3307-----	4.3296.
419	Y	Inside diameter of cage-----	4.3300 to 4.3312-----	4.3317.
	R-Y	Fit of bearing in cage-----	0.0007T to 0.0011L-----	0.0021L.

k. CONVERTER DRIVE GEAR BEARING OUTER CAGE GM-6764514.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	T	Outside diameter-----	4.6235 to 4.6240-----	
420	C	Diameter of bore in left housing-----	4.6245 to 4.6255-----	4.6265.
	T-C	Fit of cage in bore-----	0.0005L to 0.002L-----	

l. CONVERTER DRIVE SPUR GEAR BEARING GM-954502.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	V	Outside diameter-----	4.3301 to 4.3307-----	4.3296.
419	X	Inside diameter of cage-----	4.3306 to 4.3314-----	4.3319.
	V-X	Fit of bearing in cage-----	0.0001T to 0.0013L-----	0.0023L.

m. CONVERTER DRIVE SPUR GEAR (1.3-GM-6764501 or 1.4-GM-6764502).

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	W	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

n. FAN AND PUMP DRIVE SHAFT GM-6704415.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	GG	Outside diameter at front bearing-----	1.3771 to 1.3776-----	1.3768.
419	JJ	Inside diameter of front bearing-----	1.3775 to 1.3780-----	(*)
	GG-JJ	Fit of drive shaft in bearing-----	0.0001T to 0.0009L-----	0.0012L.
419	HH	Outside diameter at rear bearing-----	1.1804 to 1.1808-----	1.1801.
419	PP	Inside diameter of rear bearing-----	1.1807 to 1.1811-----	(*)
	HH-PP	Fit of drive shaft in bearing-----	0.0001T to 0.0007L-----	0.0010L.
419	RR	Inside diameter of center bearing support-----	1.1813 to 1.1823-----	1.1833.
	HH-RR	Fit of drive shaft in bearing support-----	0.0005L to 0.0019L-----	

o. FAN AND PUMP PINION FRONT BEARING GM-903207.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	KK	Outside diameter-----	2.8341 to 2.8346-----	2.8336.
	LL	Inside diameter of pinion-----	2.8340 to 2.8346-----	2.8351.
	KK-LL	Fit of bearing in pinion-----	0.0006T to 0.0005L-----	0.0015L.

p. FAN AND PUMP PINION REAR BEARING GM-903206.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	QQ	Outside diameter-----	2.4404 to 2.4409-----	2.4399.
419	NN	Inside diameter of pinion-----	2.4403 to 2.4409-----	2.4414.
	QQ-NN	Fit of bearing in pinion-----	0.0006T to 0.0005L-----	0.0015L.

q. FAN AND PUMP DRIVE PINION GM-6704420.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	MM	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

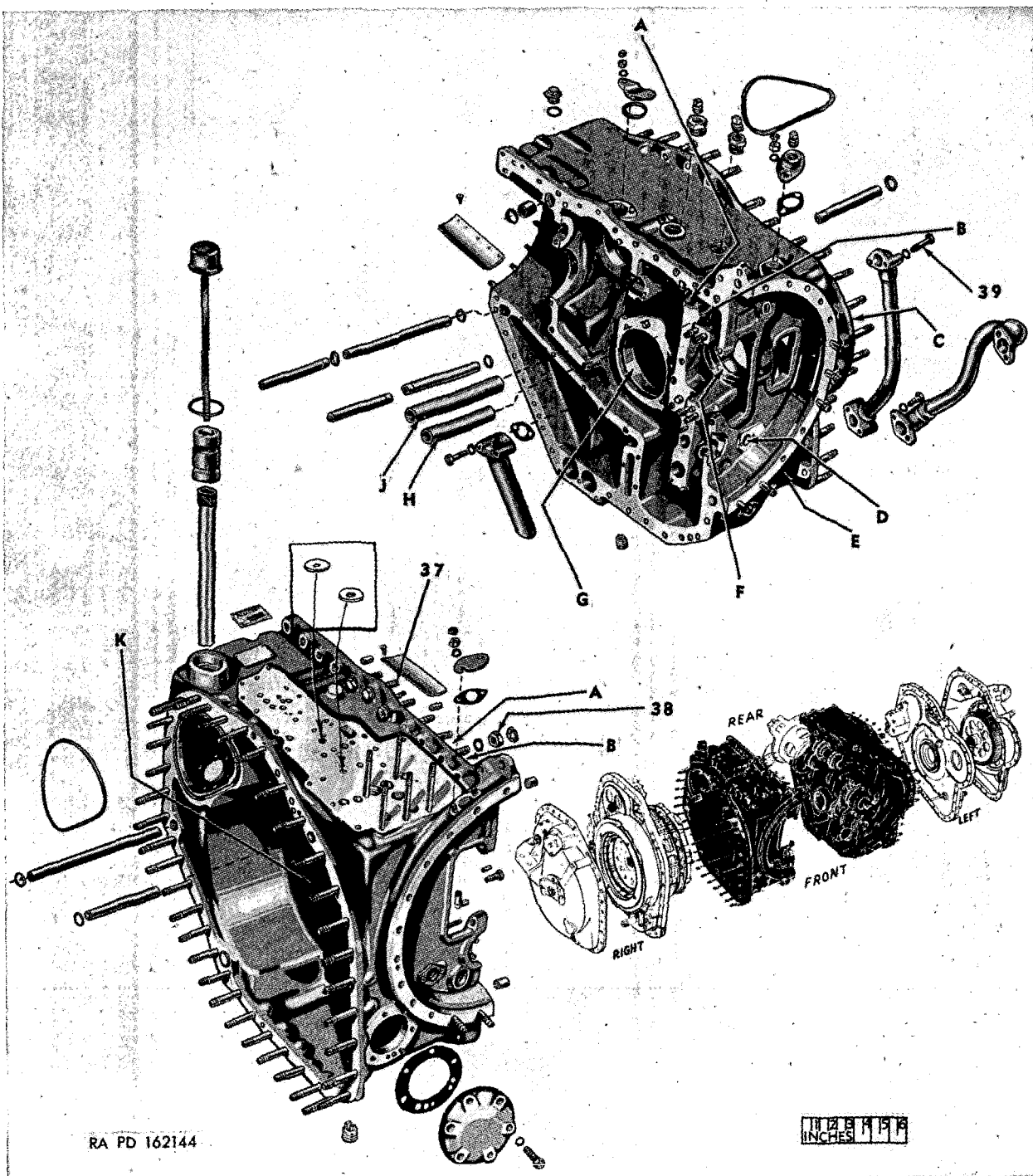


Figure 420. Serviceability standard points of measurement for left and right housings.

r. FAN AND PUMP DRIVE IDLER GEAR SPINDLE GM-6765015.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	D	Outside diameter at housing	0.9985 to 0.9990	0.9975.
420	D	Diameter of bore in left housing	0.9995 to 1.0005	1.0015.
	D-D	Fit of spindle in housing	0.0005L to 0.002L	0.004L.
421	C	Outside diameter at bearing and spacer	0.7867 to 0.7871	0.7862.
421	G	Inside diameter of bearing	0.7870 to 0.7874	0.7879.
	C-G	Fit of spindle in bearing	0.0001T to 0.0007L	0.0012L.
421	E	Inside diameter of spacer	0.7890 to 0.7895	0.7905.
	C-E	Fit of spindle in spacer	0.0019L to 0.0028L	

s. FAN DRIVE IDLER GEAR BEARING GM-905304.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	B	Outside diameter	2.0467 to 2.0472	2.0462.
421	A	Inside diameter of gear	2.0466 to 2.0472	2.0477.
	B-A	Fit of bearing in gear	0.0005L to 0.0006T	

t. FAN AND PUMP DRIVE IDLER GEAR GM-6764797.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	F	Backlash with mating gear on standard centers.	0.006 to 0.012	

u. FAN DRIVE BEARING CAGE GM-6763722.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	H	Outside diameter	3.498 to 3.499	3.497.
420	E	Inside diameter of bore in left housing	3.4995 to 3.5005	3.5015.
	H-E	Fit of cage in left housing	0.0005L to 0.0025L	

v. FAN DRIVE BEARING GM-954492.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	K	Outside diameter	2.8341 to 2.8346	2.8386.
421	J	Inside diameter of cage	2.8345 to 2.8351	2.8356.
	K-J	Fit of bearing in cage	0.0001T to 0.001L	0.002L.

w. FAN DRIVE COUPLING GM-6763726.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	M	Outside diameter at bearing	1.3779 to 1.3784	1.3776.
421	L	Inside diameter of bearing	1.3775 to 1.3780	(*)
	M-L	Fit of coupling bearing	0.0001L to 0.0009T	0.0004L.

x. FAN AND PUMP DRIVE GEAR GM-6704419.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
421	N	Backlash with mating gear on standard centers.	0.006 to 0.012	

y. PUMP DRIVE GEAR BEARING GM-905202.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
427	C	Outside diameter	1.3775 to 1.3780	1.3772.
427	B	Inside diameter of drive gear bore	1.3774 to 1.3780	1.3783.
	C-B	Fit of bearing in bore	0.0005L to 0.0006T	0.0011L.
427	D	Inside diameter	0.5903 to 0.5906	0.5911.
427	E	Outside diameter of drive spindle	0.5901 to 0.5904	0.5896.
	D-E	Fit of bearing on spindle	0.0001T to 0.0005L	0.0015L.

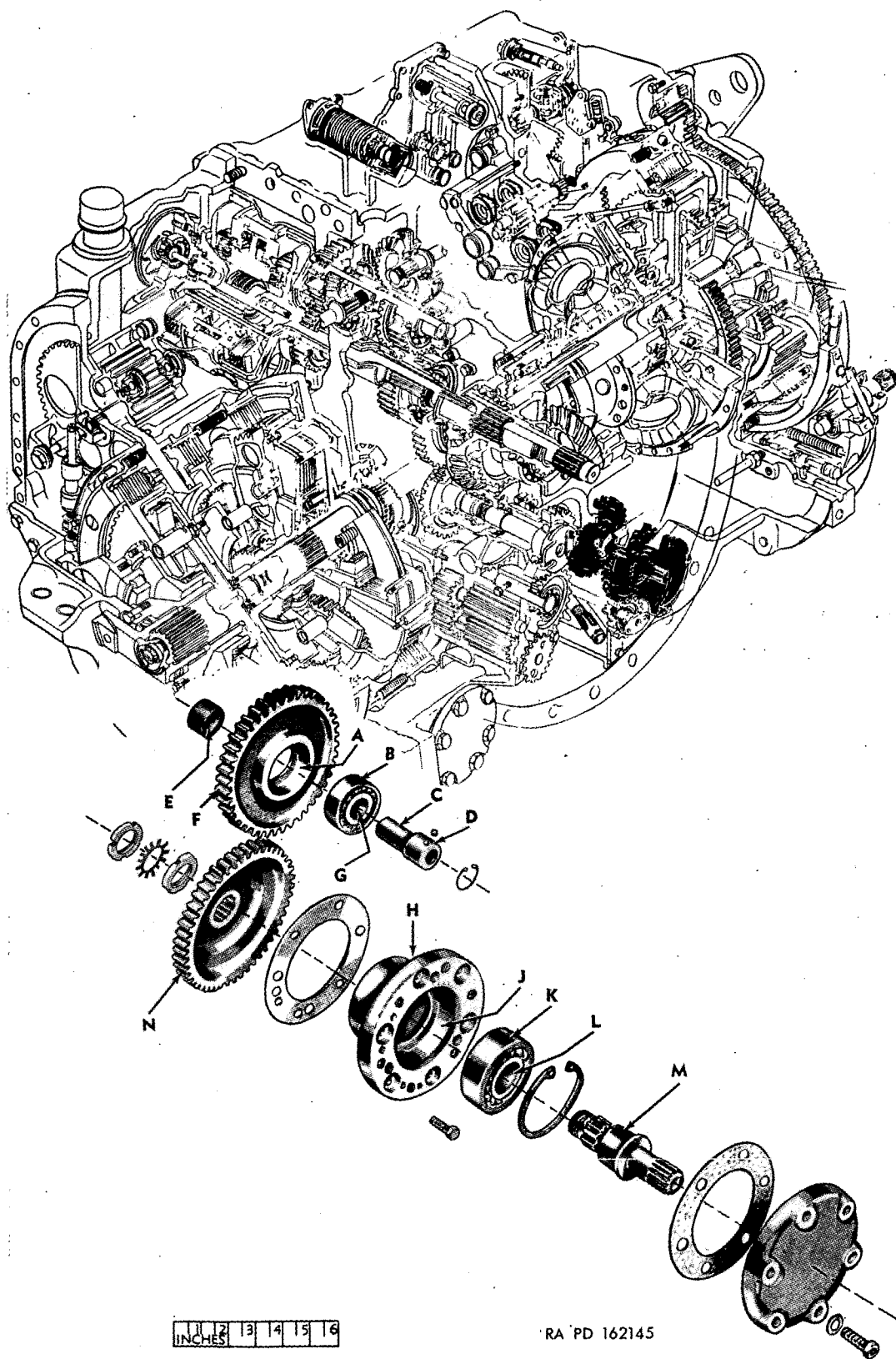


Figure 421. Serviceability standard points of measurement for left housing.

z. PUMP DRIVE GEAR GM-6764031.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
427	A	Backlash with mating gear on standard centers.	0.006 to 0.012	

aa. CONVERTER DRIVE SHAFT GM-6763701.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	VV	Outside diameter at bearings	3.5432 to 3.5439	3.5430.
419	UU	Inside diameter of bearings	3.5425 to 3.5433	3.5435.
	V-UU	Fit of shaft in bearings	0.0001L to 0.0014T	0.0005L.

ab. CONVERTER OUTPUT DRIVE SPACER GM-6760031.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	YY	Inside diameter	3.818 to 3.823	3.825.
419	WW	Outside diameter of shaft	3.807 to 3.812	3.805.
	YY-WW	Fit of spacer on shaft	0.006L to 0.016L	

ac. CONVERTER OUTPUT SHAFT DRIVING BEVEL GEAR GM-6760033.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	XX	Refer to paragraph 59l for backlash.		

ad. CONVERTER OUTPUT DRIVEN BEVEL PINION BEARING GM-954533.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	AD	Outside diameter	2.8341 to 2.8345	2.8336.
419	ZZ	Inside diameter of center bearing support	2.8345 to 2.8351	2.8356.
	AD-ZZ	Fit of bearing in support	0.000 to 0.001L	0.002L.

ae. CONVERTER OUTPUT DRIVEN BEVEL PINION GM-6760018.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	AK	Outside diameter at bearing	1.1810 to 1.1814	1.1808.
419	AC	Inside diameter of bearing	1.1807 to 1.1811	1.1813.
	AK-AC	Fit of gear in bearing	0.0001L to 0.0007T	0.0005L.
419	AL	Refer to paragraph 59l for backlash.		

af. CONVERTER OUTPUT DRIVE GEAR PINION BEARING SPACER GM-6765420.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	AE	Inside diameter	1.183 to 1.193	1.197.
419	AK	Outside diameter of pinion at spacer	1.1810 to 1.1814	1.1808.
	AE-AK	Fit of spacer on pinion	0.0016L to 0.012L	

ag. CONVERTER OUTPUT TRANSFER DRIVING GEAR BEARING GM-7450165.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	AF	Outside diameter	3.5427 to 3.5433	3.5422.
419	AB	Inside diameter of center bearing support	3.5433 to 3.5439	3.5444.
	AF-AB	Fit of bearing in support	0.000 to 0.0012L	0.0022L.

ah. CONVERTER OUTPUT TRANSFER DRIVING GEAR GM-6765329.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	AH	Outside diameter at bearing	1.9691 to 1.9697	1.9689.
419	AG	Inside diameter of bearing	1.9680 to 1.9685	1.9687.
	AH-AG	Fit of gear in bearing	0.0006T to 0.0017T	0.0002T.
419	AJ	Backlash with mating gear on standard centers.	0.006 to 0.012	

ai. CONVERTER OUTPUT TRANSFER DRIVEN GEAR GM-6765330.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	A	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

aj. INPUT SHAFT REAR BEARING GM-903214.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
419	E	Outside diameter-----	4.9205 to 4.9213-----	(*)
419	B	Diameter of bore in gear-----	4.9204 to 4.9214-----	4.9217.
	E-B	Fit of bearing in gear-----	0.0009L to 0.0009T-----	0.0012L.

ak. LEFT STEERING CLUTCH SHAFT GM-6764024.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	L	Outside diameter at bearing-----	2.7558 to 2.7564-----	2.7555.
402	P	Inside diameter of bearing-----	2.7553 to 2.7559-----	2.7562.
	L-P	Fit of shaft in bearing-----	0.0011T to 0.0001L-----	0.0007L.

al. LEFT STEERING CLUTCH SHAFT BEARING GM-903014.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	N	Outside diameter-----	4.3301 to 4.3307-----	4.3296.
402	Q	Inside diameter of cage-----	4.3306 to 4.3314-----	4.3319.
	N-Q	Fit of bearing in cage-----	0.0001T to 0.0013L-----	0.0023L.

am. STEERING CLUTCH SHAFT BUSHING GM-6764030.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	J	Outside diameter-----	0.004 to 0.007 press fit--	
402	M	Inside diameter of left shaft-----	1.9995 to 2.0005-----	2.0015.

an. RIGHT STEERING CLUTCH SHAFT GM-6763993.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	H	Outside diameter at bushings-----	1.871 to 1.872-----	1.870.
402	K	Inside diameter of bushing-----	1.875 to 1.876-----	1.880.
	H-K	Fit of shaft in bushings-----	0.003L to 0.005L-----	

ao. LEFT STEERING SHAFT GEAR GM-6765326.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	R	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

ap. RIGHT STEERING SHAFT GEAR GM-6765331.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	T	Outside diameter at bearing-----	2.1653 to 2.1659-----	2.1651.
402	W	Inside diameter of bearing-----	2.1648 to 2.1654-----	2.1656.
	T-W	Fit of gear in bearing-----	0.0011T to 0.0001L-----	0.0005L.
402	S	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

aq. RIGHT STEERING SHAFT BEARING GM-903211.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
402	V	Outside diameter-----	3.9364 to 3.9370-----	3.9359.
402	U	Inside diameter of steering shaft bearing support.	3.9369 to 3.9377-----	3.9382.
	V-U	Fit of bearing in support-----	0.0001T to 0.0013L-----	0.0023L.

ar. STEERING DIFFERENTIAL SPUR GEAR GM-6765328.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	E	Backlash with mating gear on standard centers.	0.006 to 0.012	

as. STEERING DIFFERENTIAL SPUR GEAR BALL BEARING GM-903306.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	B	Outside diameter	2.8341 to 2.8346	2.8339.
422	D	Inside diameter of bore in gear	2.8340 to 2.8346	2.8348.
	B-D	Fit of bearing in gear	0.0006T to 0.0005L	0.0009L.
422	C	Inside diameter	1.1807 to 1.1811	1.1816.
422	N	Outside diameter of shaft at bearing	1.1804 to 1.1808	1.1800.
	C-N	Fit of bearing on shaft	0.007L to 0.0001T	0.0016L.

at. STEERING DIFFERENTIAL SPUR GEAR NEEDLE BEARING GM-6704022.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	P	Outside diameter of shaft assembly at bearings.	1.2495 to 1.2500	1.2493.
422	F	Inside diameter of bore in gear	1.7495 to 1.7502	1.7405.

au. STEERING DIFFERENTIAL SHAFT GM-6760023.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	N	Outside diameter at sleeve	1.1804 to 1.808	1.1802.
422	A	Inside diameter of sleeve	1.181 to 1.182	1.1825.
	N-A	Fit of shaft in sleeve	0.0002L to 0.0016L	0.0023L.

av. STEERING DIFFERENTIAL BEVEL PINION GM-6765327.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	G	Refer to paragraph 59l for backlash		

aw. LEFT STEERING CROSS SHAFT GEAR GM-6763962.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	L	Outside diameter of bearing hub	1.7716 to 1.7721	1.7714.
422	J	Inside diameter of bearing	1.7712 to 1.7717	1.7719.
	L-J	Fit of hub in bearing	0.0009T to 0.0001L	0.0005L.
422	M	Refer to paragraph 59l for backlash		

ax. STEERING CROSS SHAFT INNER BEARING GM-903309.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
422	K	Outside diameter	3.9364 to 3.9370	3.9359.
422	H	Inside diameter of cage	3.9369 to 3.9377	3.9382.
	K-H	Fit of bearing in cage	0.0013L to 0.0001T	0.0023L.

ay. PUMP BY-PASS VALVE SPRING GM-6765693.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
423	F	Free height	4.562	
423	F	Height under 1.26 to 1.54 lb load	1.562	1.19 lb at 1.562.

az. PUMP BY-PASS VALVE GM-6765692.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
423	E	Outside diameter	1.062 to 1.067	1.057.
423	D	Inside diameter of valve sleeve	1.072 to 1.082	1.087.
	E-D	Fit of valve in sleeve	0.005L to 0.020L	0.03L.

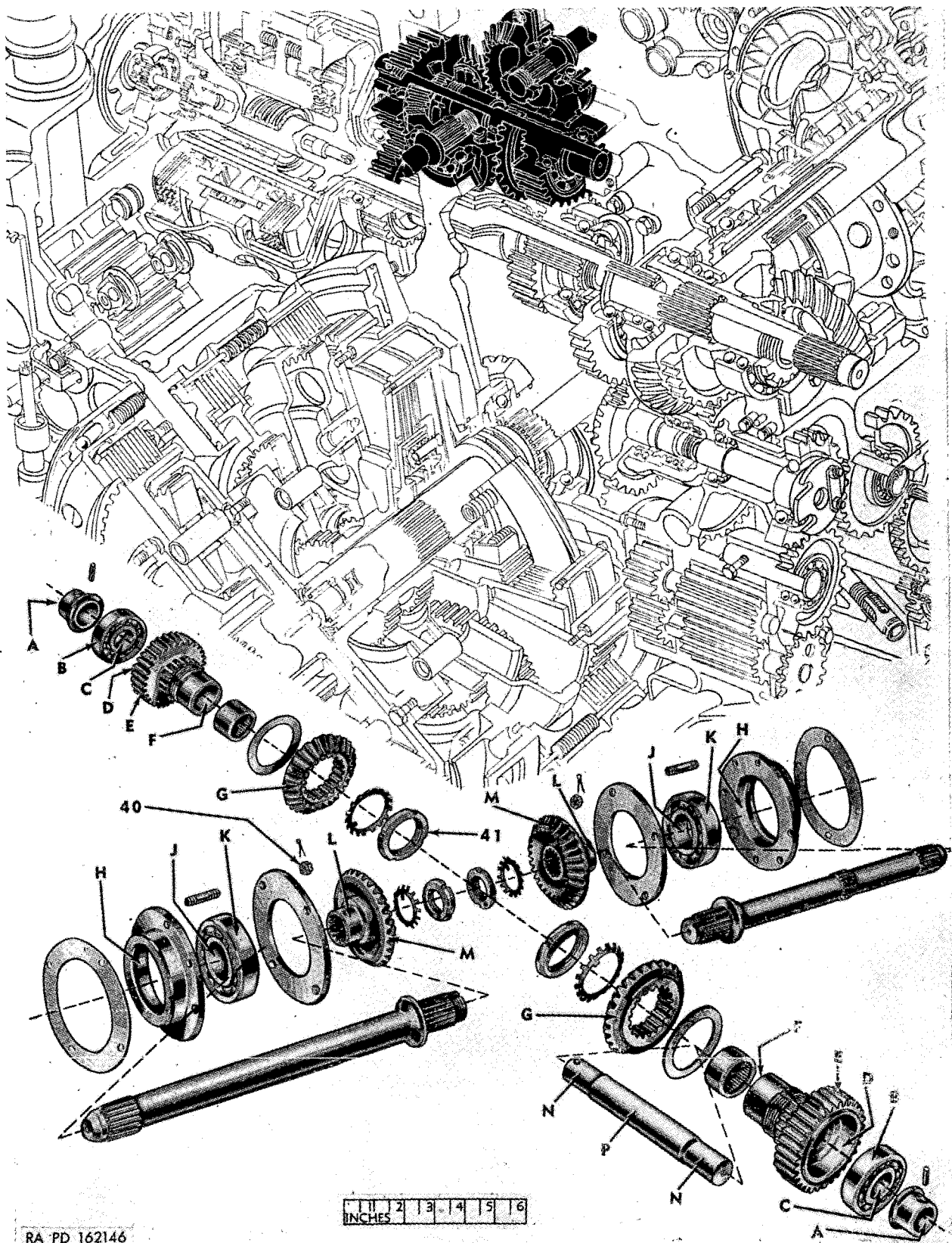
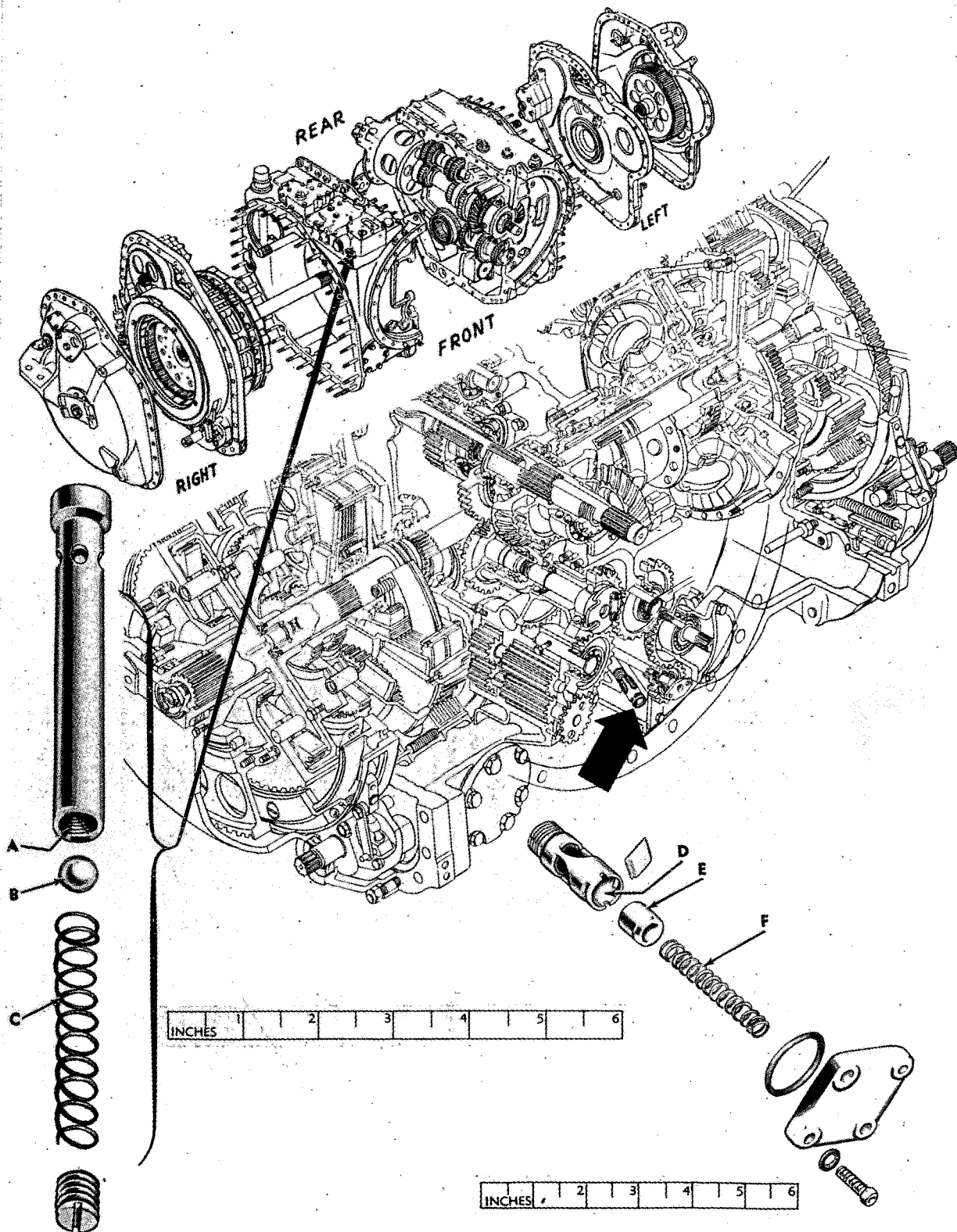


Figure 422. Serviceability standard points of measurement for left housing.



RA PD 162147

Figure 423. Serviceability standard points of measurement for left and right housings.

ba. CONVERTER GROUND SLEEVE GM-6763920.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
413	R	Outside diameter at left housing	5.999 to 5.9995	5.9985.
420	G	Diameter of bore in left housing	5.9995 to 6.0005	6.0010.
	R-G	Fit of ground sleeve in left housing	0.000 to 0.0015L	

bb. CONVERTER "IN" OIL TUBE GM-6760259

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
420	J	Outside diameter	1.1125 to 1.1135	
420	A	Inside diameter of bore in left and right housings.	1.111 to 1.112	
	J-A	Fit of tube in housings	0.0005T to 0.0025T	

bc. CONVERTER "OUT" OIL TUBE GM-6760256.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
420	H	Outside diameter	1.2375 to 1.2385	
420	B	Inside diameter of bore in left and right housings.	1.236 to 1.237	
	H-B	Fit of tube in housings	0.0005T to 0.0025T	

103. Right Housing

(Par. 62)

a. OIL ACCUMULATOR PISTON SPRING GM-6762675.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
424	B	Free height	$4\frac{5}{64}$	
424	B	Height under 690.3 to 843.7 lb load	$2\frac{23}{32}$	650 lb at $2\frac{23}{32}$.

b. OIL ACCUMULATOR PISTON GM-6762607.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
424	C	Outside diameter	3.119 to 3.123	3.118.
424	E	Inside diameter of accumulator body	3.125 to 3.130	3.131.
	C-E	Fit of piston in body	0.002L to 0.011L	

c. OIL ACCUMULATOR PISTON SPRING RETAINER PLATE GM-6762632.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
424	A	Outside diameter	3.175 to 3.180	3.173.
424	D	Inside diameter of bore in accumulator body.	3.182 to 3.192	3.195.
	A-D	Fit of plate in body	0.002L to 0.017L	0.021L.

d. MAIN PRESSURE RELIEF VALVE BODY GM-6760375.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
423	A	Inside diameter	0.763 to 0.770	0.771.
423	B	Diameter of ball	0.7495 to 0.7505	0.7490.
	A-B	Fit of ball in body	0.0125L to 0.0205L	

e. MAIN PRESSURE RELIEF VALVE SPRING GM-8894438.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
423	C	Free height	$3\frac{15}{32}$	
423	C	Height under 51 to 61 lb load	$2\frac{11}{16}$	48.5 lb at $2\frac{11}{16}$.

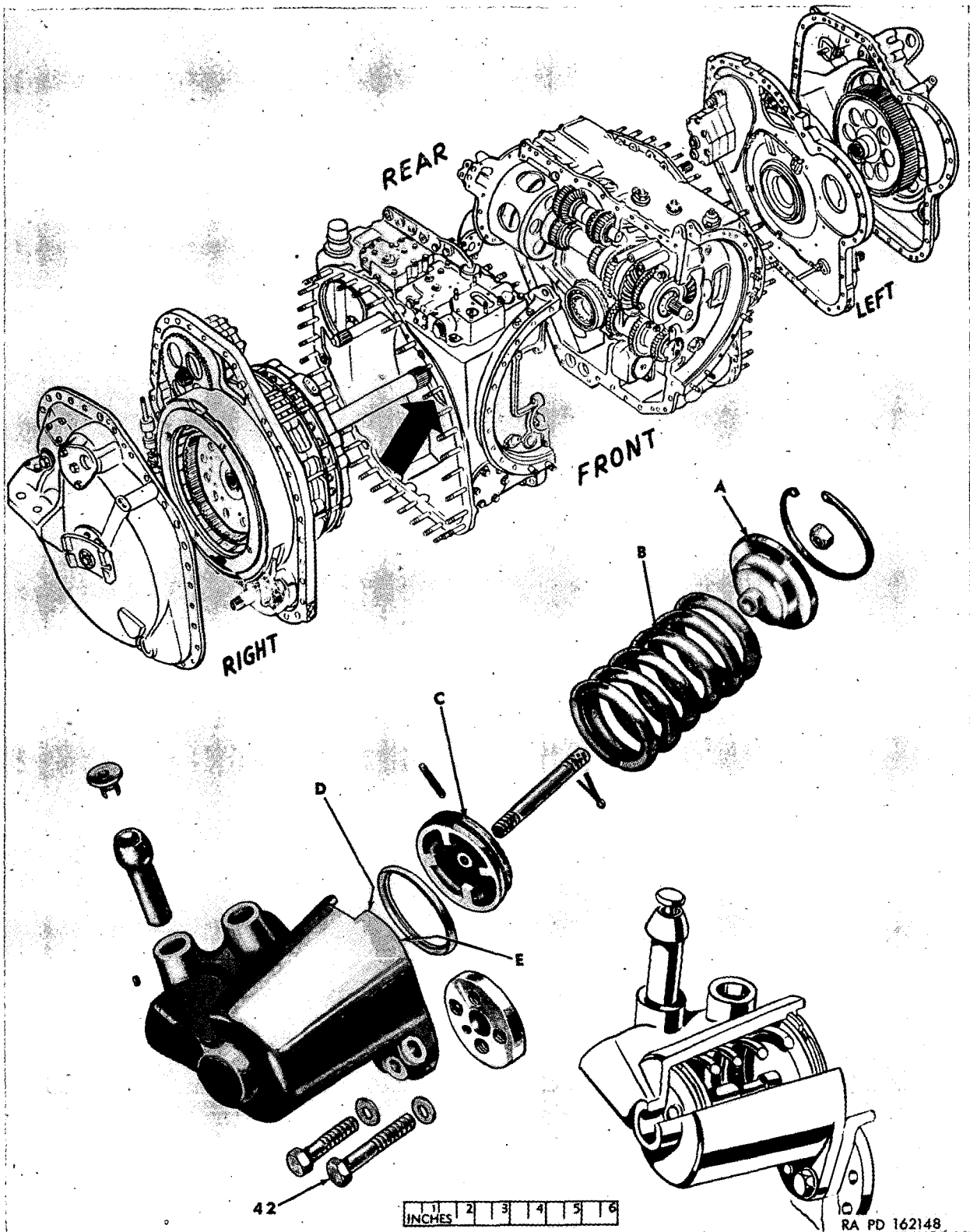


Figure 424. Serviceability standard points of measurement for right housing.

104. Steering Clutch Coolant Pump and Relief Valve

(Par. 66)

a. STEERING CLUTCH COOLANT PUMP BEARING GM-954498.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
425	B	Outside diameter.....	1.3775 to 1.3780.....	1.3770.
425	A	Inside diameter of bore in cover.....	1.3782 to 1.3792.....	1.3797.
	B-A	Fit of bearing in cover.....	0.0002L to 0.0017L.....	0.0027L.
425	C	Inside diameter.....	0.5903 to 0.5906.....	0.5911.
425	F	Outside diameter of shaft.....	0.5894 to 0.5901.....	0.589.
	C-F	Fit of bearing on shaft.....	0.0002L to 0.0012L.....	0.0022L.

b. STEERING CLUTCH COOLANT PUMP OUTER ROTOR GM-6765373.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
425	D	Outside diameter.....	3.3745 to 3.375.....	3.3645.
425	E	Inside diameter of pump body.....	3.3920 to 3.3925.....	3.3935.
	D-E	Running clearance in pump body.....	0.017L to 0.018L.....	0.0195L.

c. REGULATOR VALVE GM-6766190.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
425	J	Outside diameter of pilot.....	0.219 to 0.229.....	0.217.
425	G	Inside diameter of bore in guide.....	0.245 to 0.251.....	0.253.
	J-G	Fit of pilot in guide.....	0.016L to 0.032L.....	

d. RELIEF VALVE SPRING GM-6763927.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
425	H	Free height.....	3.103.....	
425	H	Height under 27 to 33 lb. load.....	1.390.....	25.5 lbs. at 1.390.

105. Input Scavenge and Converter Pump

(Par. 70)

a. PUMP BODY GM-6765637.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	F	Inside diameter for gears.....	1.836 to 1.837.....	1.840.

b. CONVERTER CIRCULATING PUMP IDLER GEAR GM-6765589.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	A	Outside diameter.....	1.831 to 1.832.....	1.830.
	A-F	Running clearance in pump body.....	0.004 to 0.006.....	
426	A	Backlash with mating gear on standard centers.....	0.004 to 0.008.....	

c. IDLER GEAR BUSHING GM-6760678.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	B	Inside diameter of gears.....	0.7495 to 0.7505.....	0.7510.
	C-B	Fit of busings in oil pump gears.....	0.001 to 0.003 press fit..	
426	D	Inside diameter after reaming.....	0.624 to 0.625.....	0.627.
426	J	Outside diameter of idler gear shaft.....	0.6225 to 0.623.....	0.6220.
	J-D	Fit of shaft in bushings.....	0.001L to 0.0025L.....	0.005L.

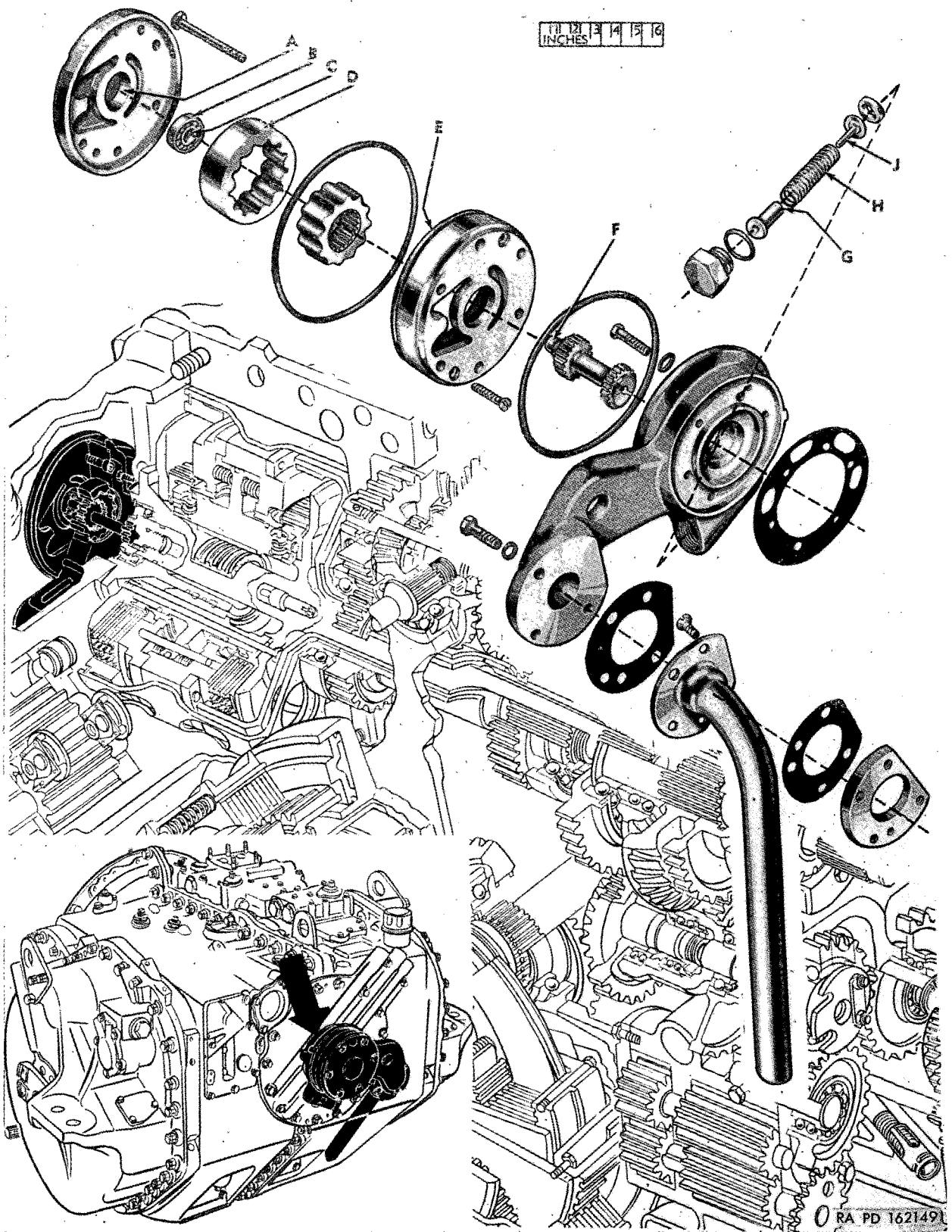


Figure 425. Serviceability standard points of measurement for steering clutch coolant pump and relief valve.

d. CONVERTER CIRCULATING PUMP GEAR GM-6765588.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	G	Outside diameter	1.831 to 1.832	1.830.
	G-F	Running clearance in pump body	0.004 to 0.006	
426	G	Backlash with mating gear on standard centers.	0.004 to 0.008	

e. PUMP IDLER GEAR BEARING GM-905203.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	M	Outside diameter	1.5743 to 1.5748	(*)
426	L	Inside diameter of idler gear bore	1.5742 to 1.5748	1.5751.
	M-L	Fit of bearing in bore	0.0005L to 0.0006T	0.0008L.
426	N	Inside diameter	0.6690 to 0.6693	0.6698.
426	P	Outside diameter of idler gear shaft	0.6688 to 0.6691	0.6683.
	N-P	Fit of bearing on shaft	0.0001T to 0.0005L	0.0015L.

f. PUMP IDLER GEAR SHAFT GM-6765636.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	P	Outside diameter	0.6688 to 0.6691	0.6683.
426	E	Inside diameter of bore in pump body	0.6696 to 0.6713	0.6723.
	P-E	Fit of shaft in bore	0.0005L to 0.0025L	0.004L.

g. PUMP IDLER GEAR SHAFT GM-6765635.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	J	Outside diameter	0.6225 to 0.623	0.622.
426	H	Inside diameter of bore in front cover	0.625 to 0.626	0.627.
	J-H	Fit of shaft in bore	0.002L to 0.0035L	0.005L.

h. PUMP DRIVE IDLER GEAR GM-6765630.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	K	Backlash with mating gear on standard centers.	0.006 to 0.012	

i. PUMP DRIVE SHAFT GM-6765632.

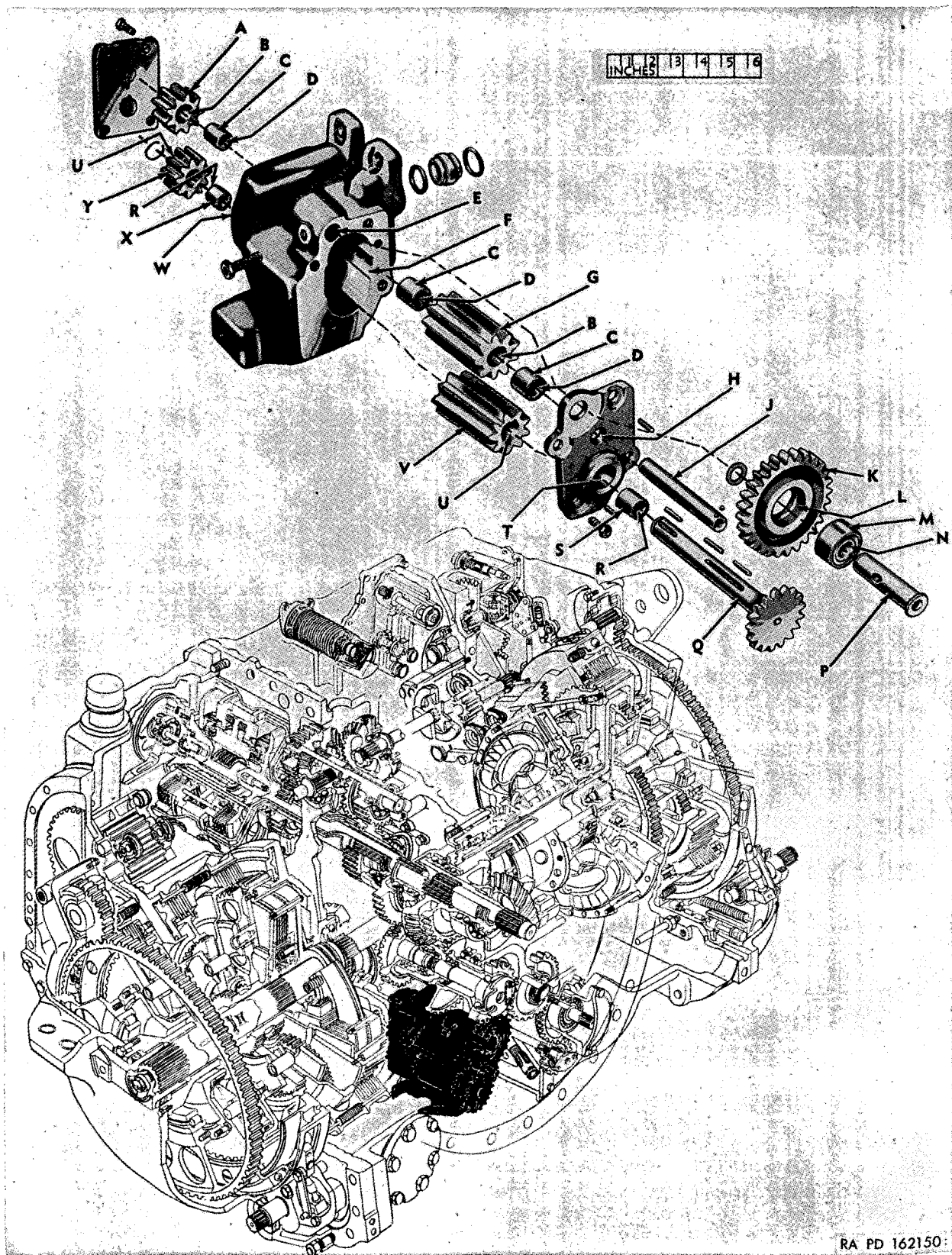
Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	Q	Outside diameter	0.7475 to 0.7480	0.7470.
426	R	Inside diameter of bushings after reaming	0.749 to 0.750	0.751.
	Q-R	Fit of shaft in bushings	0.001L to 0.0025L	0.004L.
426	U	Inside diameter of pump gears	0.7495 to 0.7505	0.7515.
	Q-U	Fit of shaft in gears	0.0015L to 0.003L	0.0045L.

j. PUMP DRIVE SHAFT BUSHING GM-6765629.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	T	Inside diameter of front cover bore	0.8745 to 0.8755	
	S-T	Fit of bushing in bore	0.002 to 0.004 press fit	0.0015.
426	W	Inside diameter of body bore	0.8745 to 0.8755	
	X-W	Fit of bushing in bore	0.002 to 0.004 press fit	0.0015.

k. PUMP DRIVE GEAR GM-6765587.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
426	V	Outside diameter	1.831 to 1.832	1.830.
	V-F	Running clearance in pump body	0.004 to 0.006	
426	V	Backlash with mating gear on standard centers.	0.004 to 0.008	



RA PD 162150

Figure 426. Serviceability standard points of measurement for input scavenge and converter pump.

l. PUMP DRIVE GEAR GM-6765484.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
426	Y	Outside diameter-----	1.831 to 1.832-----	1.830.
	Y-F	Running clearance in pump body-----	0.004 to 0.006-----	
426	Y	Backlash with mating gear on standard centers.	0.004 to 0.008-----	

106. Input Pressure Pump

(Par. 74)

a. PUMP HOUSING GM-6764010.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	M	Inside diameter for gears-----	1.836 to 1.837-----	1.840.

b. PUMP IDLER GEAR SHAFT GM-6764012.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	L	Outside diameter-----	0.6225 to 0.6230-----	0.6220.
427	F	Inside diameter of bores in cover and base-----	0.6235 to 0.6245-----	0.6250.
	L-F	Fit of shaft in bores-----	0.0005L to 0.002L-----	0.003L.
427	G	Inside diameter of bushing after reaming-----	0.624 to 0.625-----	0.627.
	L-G	Fit of shaft in bushing-----	0.001L to 0.0025L-----	0.004L.

c. PUMP IDLER GEAR GM-6704492.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	K	Outside diameter-----	1.831 to 1.832-----	1.830.
	K-M	Running clearance in pump body-----	0.004 to 0.006-----	
427	K	Backlash with mating gear on standard centers.	0.004 to 0.008-----	

d. PUMP IDLER GEAR BUSHING GM-6704194.

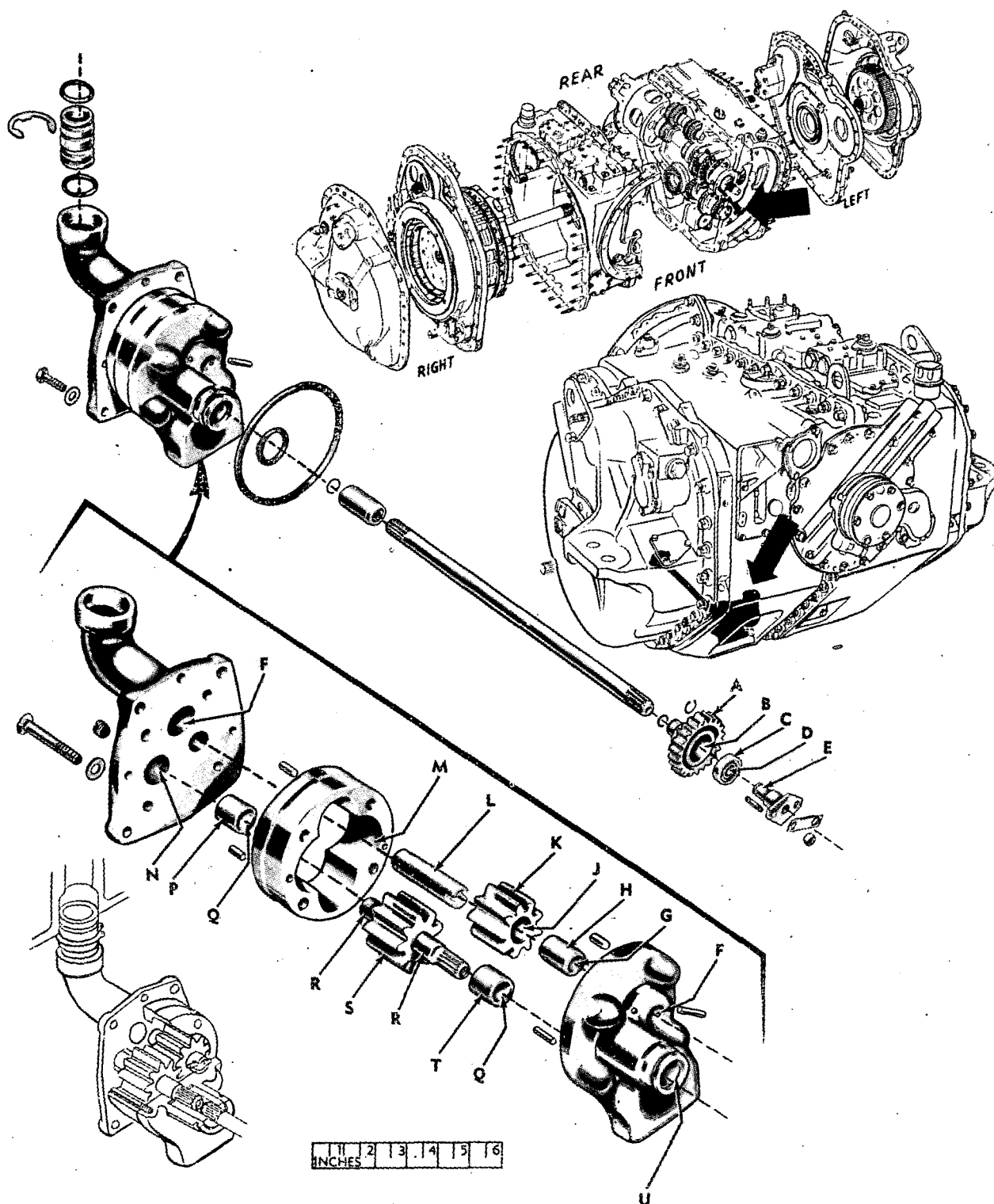
<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	J	Inside diameter of bore in idler gear-----	0.7495 to 0.7505-----	0.7510.
	H-J	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.

e. PUMP INTERNAL DRIVE GEAR BUSHING GM-6704193.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	U	Inside diameter of base bore-----	0.7495 to 0.7505-----	0.7510.
	T-U	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.
427	N	Inside diameter of cover bore-----	0.7495 to 0.7505-----	0.7510.
	P-N	Fit of bushing in bore-----	0.002 to 0.004-----	0.0015.

f. PUMP INTERNAL DRIVE GEAR GM-6764011.

<i>Figure No.</i>	<i>Reference letter</i>	<i>Point of measurement</i>	<i>Sizes and fits of new parts</i>	<i>Wear limits</i>
427	S	Outside diameter-----	1.831 to 1.832-----	1.830.
	S-M	Running clearance in pump body-----	0.004 to 0.006-----	0.008.
427	S	Backlash with mating gear on standard centers.	0.004 to 0.008-----	
427	R	Outside diameter of gear journal-----	0.6225 to 0.6230-----	0.6220.
427	Q	Inside diameter of bushings after reaming-----	0.624 to 0.625-----	0.627.
	R-Q	Fit of journal in bushings-----	0.001L to 0.0025L-----	0.005L.



RA PD 162151

Figure 427. Serviceability standard points of measurement for input pressure pump.

107. Output Brake and Pressure Pump

(Par. 78)

a. PUMP GEAR HOUSING GM-6763840.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	J	Inside diameter for gears-----	1.836 to 1.837-----	1.840.

b. PUMP GEAR BUSHING GM-6765320.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	C	Inside diameter of bore in pump housing-----	0.8745 to 0.8755-----	0.8760.
	B-C	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.
428	K	Inside diameter of bore in pump base-----	0.8745 to 0.8755-----	0.8760.
	L-K	Fit of bushings in bore-----	0.002 to 0.004 press fit--	0.0015.

c. PUMP INTERNAL DRIVE GEAR GM-6765306.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	H	Outside diameter-----	1.831 to 1.832-----	1.830.
	H-J	Running clearance in pump housing-----	0.004 to 0.006-----	
428	H	Backlash with mating gear on standard centers-----	0.004 to 0.008-----	
428	G	Outside diameter of gear journal-----	0.7475 to 0.7480-----	0.7470.
428	A	Inside diameter of bushings after reaming-----	0.749 to 0.750-----	0.752.
	G-A	Fit of journal in bushings-----	0.001L to 0.0025L-----	0.005L.

d. PUMP IDLER GEAR GM-6704492.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	P	Outside diameter-----	1.831 to 1.832-----	1.830.
	P-J	Running clearance in pump housing-----	0.004 to 0.006-----	
428	P	Backlash with mating gears on standard centers-----	0.004 to 0.008-----	

e. PUMP IDLER GEAR BUSHING GM-6704194.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	Q	Inside diameter of idler gear bore-----	0.7495 to 0.7505-----	0.7510.
	N-Q	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.

f. PUMP IDLER GEAR SHAFT GM-6760042.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	R	Outside diameter-----	0.6225 to 0.623-----	0.6220.
428	M	Inside diameter of bushing after reaming-----	0.624 to 0.625-----	0.627.
	R-M	Fit of shaft in bushing-----	0.001L to 0.0025L-----	0.005L.
428	F	Inside diameter of bores in base and housing-----	0.6235 to 0.6245-----	0.6250.
	R-F	Fit of shaft in bores-----	0.0005L to 0.002L-----	0.003L.

g. PUMP DRIVE GEAR GM-6765308.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	S	Backlash with mating gear on standard centers-----	0.006 to 0.012-----	

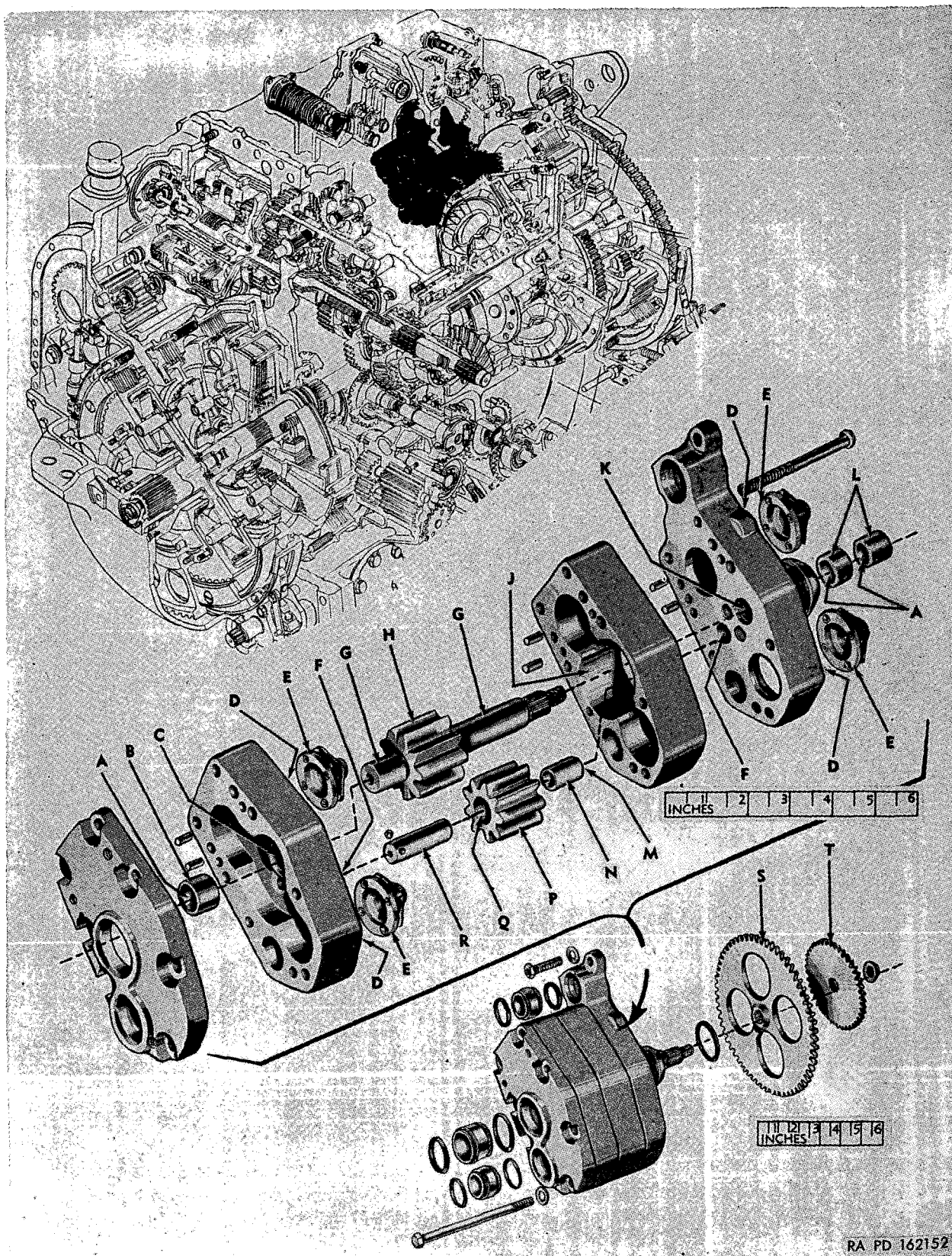


Figure 428. Serviceability standard points of measurement for output brake and pressure pump.

h. GOVERNOR DRIVE GEAR GM-6765309.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	T	Backlash with mating gear on standard centers.	0.006 to 0.012-----	

i. CHECK VALVE ASSEMBLY GM-6763785.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
428	E	Outside diameter-----	1.7510 to 1.7515-----	(*)
428	D	Inside diameter of bores-----	1.7495 to 1.7505-----	(*)
	E-D	Fit of valves in bores-----	0.0005T to 0.002T-----	

108. Output Sump Pump

(Par. 82)

a. PUMP DRIVE GEAR GM-6765305.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	A	Backlash with mating gear on standard centers.	0.008 to 0.014-----	

b. PUMP BODY GM-6763793.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	J	Inside diameter for gears-----	1.836 to 1.837-----	1.840.

c. PUMP IDLER GEAR BUSHING GM-6704193.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	K	Inside diameter of bore in base-----	0.7495 to 0.7505-----	0.7510.
	L-K	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.
429	C	Inside diameter of bore in cover-----	0.7495 to 0.7505-----	0.7510.
	F-C	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.

d. PUMP IDLER GEAR GM-6765322.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	H	Outside diameter-----	1.831 to 1.832-----	1.830.
	H-J	Running clearance in pump body-----	0.004 to 0.006-----	
429	H	Backlash with mating gear on standard centers.	0.004 to 0.008-----	
429	G	Outside diameter of journals-----	0.6225 to 0.6230-----	0.6220.
429	E	Inside diameter of bushings after reaming--	0.624 to 0.625-----	0.627.
	G-E	Fit of journals in bushings-----	0.001L to 0.0025L-----	0.005L.

e. PUMP INTERNAL DRIVE GEAR BUSHING GM-6765320.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	T	Inside diameter of cover bore-----	0.8745 to 0.8755-----	0.8760.
	S-T	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.

f. PUMP INTERNAL DRIVE GEAR BUSHING GM-6765321.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	P	Inside diameter of base bore-----	0.8745 to 0.8755-----	0.8760.
	N-P	Fit of bushing in bore-----	0.002 to 0.004 press fit--	0.0015.

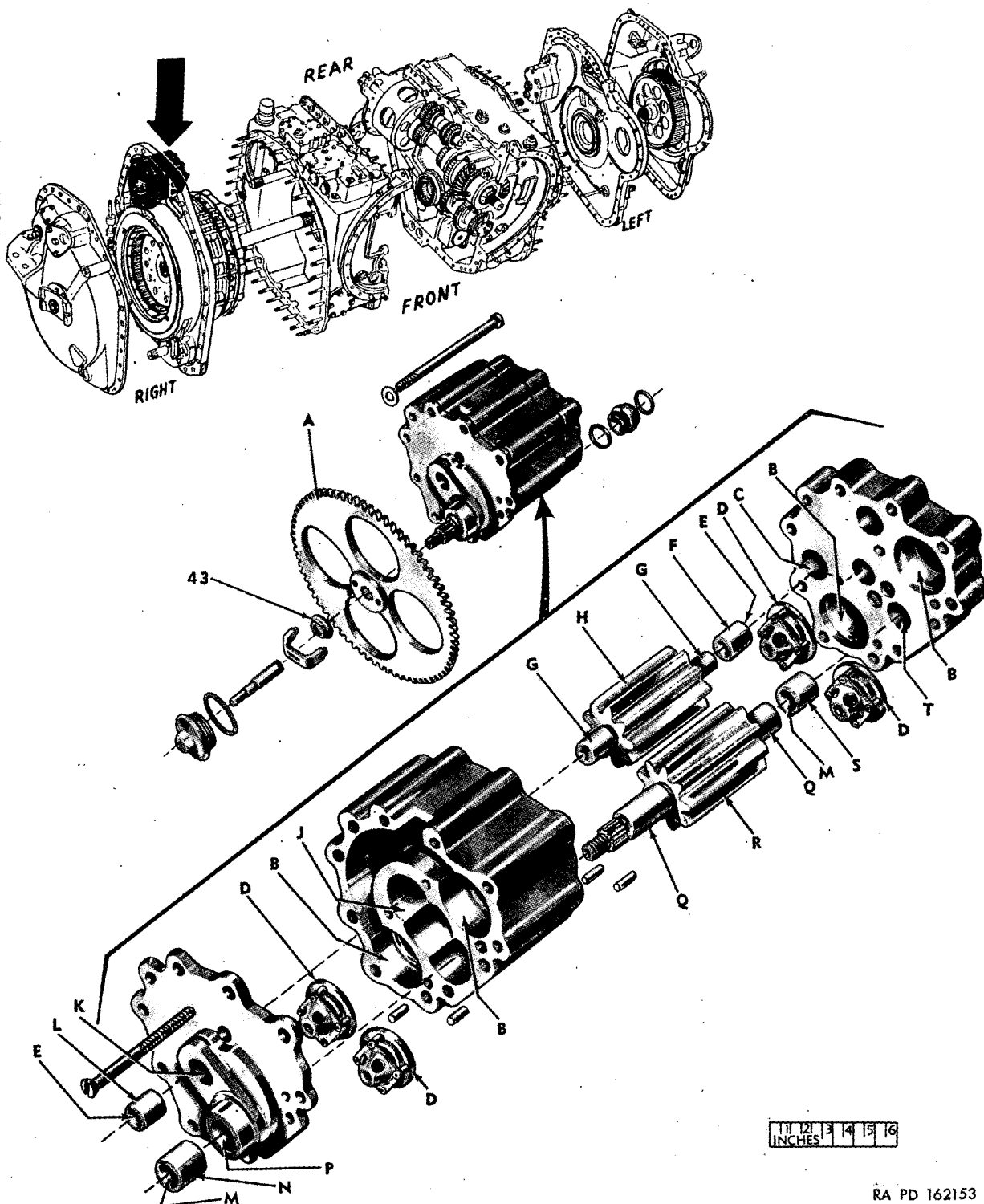


Figure 429. Serviceability standard points of measurement for output sump pump.

g. PUMP INTERNAL DRIVE GEAR GM-6765307.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	R	Outside diameter.....	1.831 to 1.832.....	1.830.
	R-J	Running clearance in pump body.....	0.004 to 0.006.....	
429	R	Backlash with mating gear on standard centers.	0.004 to 0.008.....	
429	Q	Outside diameter of journals.....	0.7475 to 0.7480.....	0.7465.
429	M	Inside diameter of bushings after reaming.	0.749 to 0.750.....	0.752.
	Q-M	Fit of journals in bushings.....	0.001L to 0.0025L.....	0.005L.

h. CHECK VALVE ASSEMBLY GM-6763785.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limits
429	D	Outside diameter.....	1.7510 to 1.7515.....	
429	B	Inside diameter of bores.....	1.7495 to 1.7505.....	1.7510.
	D-B	Fit of valves in bores.....	0.0005T to 0.002T.....	

109. Steering Overspeed Limit Pump

(Par. 86)

a. PUMP ROTOR GM-6765410.

Figure No.	Reference letter	Point of measurement	Sizes and fits of new parts	Wear limit
430	A	Outside diameter.....	3.600.....	3.580.
430	B	Inside diameter of pump head.....	3 ² / ₃₂	3.886
	A-B	Running clearance of rotor in head.....	0.306.....	0.346.

110. Transmission Torque Wrench Specifications

Figure No.	Reference No.	Location	Torque lb-ft	Figure No.	Reference No.	Location	Torque lb-ft
401	1	Steering-clutch-pack bolt.	17-20	410	14	Brake-anchor to end-plate bolt.	33-40
402	2	Steering clutch-pack rear bearing lock screw.	200-225	413	15	Converter ground-sleeve to left housing bolt.	33-40
402	3	Left steering-shaft lock nut.	300	413	16	Lock-up clutch housing to converter pump drive gear bolt.	17-20
402	4	Right steering-shaft lock nut.	350	413	17	Lock-up clutch housing to converter pump bolt.	17-20
404	5	Converter-oil-filter-tube-assembly-to-body bolt.	33-40	414	18	Right end-plate to reverse range clutch housing bolt.	33-40
404	6	Main oil-filter bolt.....	33-40	414	19	Reverse range ring gear to low range planet carrier bolt.	50-60
404	7	Sump oil-filter bolt.....	17-20	415	20	High range clutch housing to high range clutch pinion bolt.	17-20
405	8	Output-flange lock screw	150-200	416	21	Reverse range clutch housing to hub bolt.	17-20
405	9	End-cover to end-cover-hub bolt	26-32	417	22	Main pressure regulator valve plug.	90-100
405	10	Output-sun-gear to steering-output-gear bolt.	83-100				
406	11	Converter lock-up governor to end-cover bolt.	17-20				
407	12	Output planet carrier to output shaft bolt.	50-60				
407	13	Reverse range planet carrier to plate bolt.	50-60				

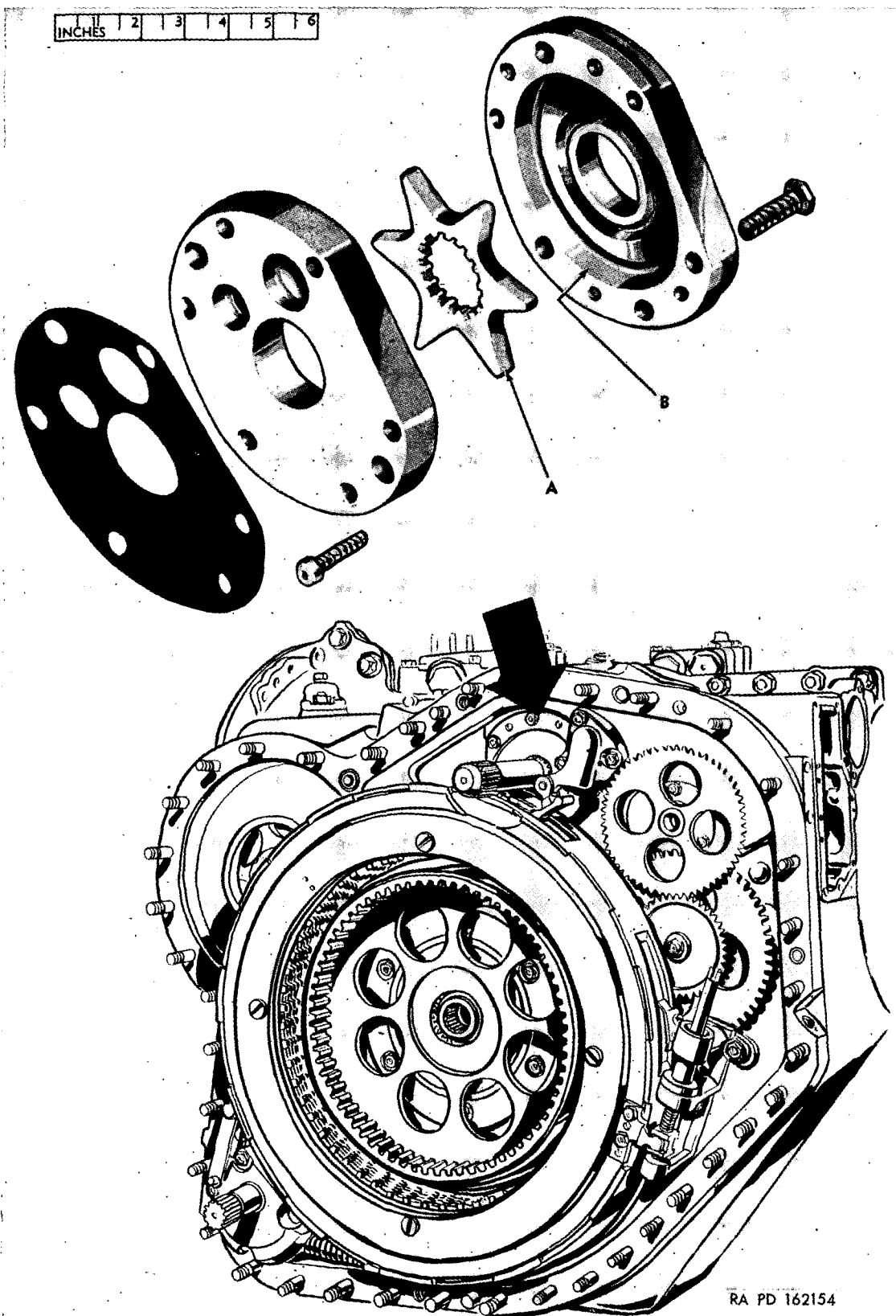


Figure 430. Serviceability standard points of measurement for steering overspeed limit pump.

<i>Figure No.</i>	<i>Refer- ence No.</i>	<i>Location</i>	<i>Torque lb-ft</i>	<i>Figure No.</i>	<i>Refer- ence No.</i>	<i>Location</i>	<i>Torque lb-ft</i>
417	23	Steering overspeed safety valve plug.	50-60	419	34	Converter drive gear spanner nut.	300
417	24	Control valve body to housing bolt.	33-40	419	35	Input shaft lock nut----	350
417	25	Detent poppet plug-----	40-50	419	36	Input shaft front bearing retainer to support bolt.	15-18
417	26	Lubrication valve plug--	90-100	420	37	Left housing to right housing bolt.	42-50
417	27	Converter regulator valve plug.	90-100	420	38	Left housing to right housing stud nut.	42-50
418	28	Steering valve body plate to housing bolt.	17-20	420	39	Input scavenge pump outlet tube to housing bolt.	17-20
418	29	Steering valve body to plate and to housing bolt.	17-20	422	40	Steering cross shaft bearing retainer to housing stud nut.	9-11
418	30	Right steering valve assembly plug.	90-100	422	41	Steering bevel pinion nut.	350
418	31	Left steering valve assembly plug.	90-100	424	42	Low-range accumulator to right housing bolt.	67-80
419	32	Converter output bevel gear shaft nut.	400	429	43	Output sump pump drive gear retainer nut.	30
419	33	Converter output drive pinion nut.	200				

APPENDIX

REFERENCES

1. Publication Indexes

The following publication indexes and lists of current issue should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to matériel covered in this manual:

Index of Administrative Publications (Army Regulations, Special Regulations, Joint Army-Air Force Adjustment Regulations, General Orders, Bulletins, Circulars, Commercial Traffic Bulletins, Army Procurement Circulars, Department of the Army Pamphlets, and ASF Manuals).	SR 310-20-5
Index of Army Motion Pictures, Kinescope Recordings, and Film Strips.	SR 110-1-1
Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Army Training Tests, Graphic Training Aids, Joint Army-Navy Air Force Publications, Combined Communications Board Publications, and Army Communications Publications).	SR 310-20-3
Index of Blank Forms and Army Personnel Classification Tests.	SR 310-20-6
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.	SR 310-20-4
Introduction and Index (supply catalogs).	ORD 1
Military Training Aids.	FM 21-8
Ordnance Major Items and Major Combinations and Pertinent Publications.	SB 9-1

2. Supply Catalogs

The following catalogs of the Department of the Army Supply Catalog pertain to this matériel:

a. REPAIR AND REBUILD.

Antifriction Bearings and Related Items.	ORD 5 SNL H-12
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K-1
Items of Soldering, Metallizing, Brazing and Welding Materials; Gases and Related Items.	ORD 3 SNL K-2
Lubricating Equipment, Accessories and Related Dispensers.	ORD (*) SNL K-3
Miscellaneous Hardware.	ORD 5 SNL H-2
Oil Seals.	ORD 5 SNL H-13
Ordnance Maintenance Sets.	ORD 6 SNL N-21
Pipe and Hose Fittings.	ORD 5 SNL H-6
Standard Hardware.	ORD 5 SNL H-1
Tool Sets (Special), Motor Vehicles.	ORD 6 SNL G-27, Sec. 1

b. VEHICLES.

Gun, Twin, 40-mm, Self-Propelled, T141.	ORD (*) SNL G-253
Howitzer, 105-mm, Self-Propelled, T98E1.	ORD (*) SNL G-258

*See ORD 1 for published catalogs of the ordnance section of the Department of the Army Supply Catalog.

Howitzer, 155-mm, Self-Propelled, T99E1.....	ORD (*) SNL G-257
Tank, 76-mm Gun, T41E1.....	ORD (*) SNL G-251
Tractor, Cargo, M8E2.....	ORD (*) SNL G-252
Vehicle, Armored Infantry, Full-Track, T18E1.....	ORD (*) SNL G-260

3. Forms

The following forms are applicable to this matériel:

DA AGO Form 9-69, Spot Check Inspection Report for all Full-Track and Tank-Like Wheeled Vehicles
DA AGO Form 9-71, Locator and Inventory Control Card
DA AGO Form 9-72, Ordnance Stock Record Card
DA AGO Form 9-76, Request for Work Order
DA AGO Form 9-77, Job Order Register
DA AGO Form 9-78, Job Order
DA AGO Form 9-79, Parts Requisition
DA AGO Form 9-80, Job Order File
DA AGO Form 9-81, Exchange Part or Unit Identification Tag
DA AGO Form 460, Preventive Maintenance Roster
DA AGO Form 461-5, Limited Technical Inspection
DA AGO Form 462, Preventive Maintenance Service and Inspection for Full-Track Vehicles
DA AGO Form 468, Unsatisfactory Equipment Report
DA AGO Form 865, Work Order
DA AGO Form 866, Consolidation of Parts
DA AGO Form 867, Status of Modification Work Order
DD Form 6, Report of Damaged or Improper Shipment

4. Other Publications

The following publications contain information pertinent to this matériel and associated equipment:

a. CAMOUFLAGE.

Camouflage.....	TM 5-267
Camouflage, Basic Principles.....	FM 5-20
Camouflage of Vehicles.....	FM 5-20B

b. DECONTAMINATION.

Decontamination.....	TM 3-220
Decontamination of Armored Force Vehicles.....	FM 17-59
Defense Against Chemical Attack.....	FM 21-40

c. DESTRUCTION TO PREVENT ENEMY USE.

Explosives and Demolitions.....	FM 5-25
Ordnance Service in the Field.....	FM 9-5

d. GENERAL.

Cooling Systems: Vehicles and Powered Ground Equipment.....	TM 9-2858
Inspection of Ordnance Matériel.....	TM 9-1100
Ordnance Field Maintenance.....	FM 9-10
Painting Instructions for Field Use.....	TM 9-2851
Precautions in Handling Gasoline.....	AR 850-20
Principles of Automotive Vehicles.....	TM 9-2700
Report of Accident Experience.....	SR 385-10-40
Storage Batteries—Lead-Acid Type.....	TM 9-2857
Supplies and Equipment: Unsatisfactory Equipment Report (Reports Control Symbol CSGlobal-247).	SR 700-45-5

*See ORD 1 for published catalogs of the ordnance section of the Department of the Army Supply Catalog.

e. REPAIR AND REBUILD.

Cleaning, Preserving, Sealing and Related Materials Issued for Ordnance Matériel	TM 9-850
Instruction Guide, Care and Maintenance of Ball and Roller Bearings	TM 37-265
Instruction Guide, Welding Theory and Application	TM 9-2852
Lubrication	TM 9-2835
Maintenance and Care of Hand Tools	TM 9-867
Maintenance and Care of Pneumatic Tires and Rubber Treads	TM 31-200
Maintenance of Supplies and Equipment: Maintenance Responsibilities and Shop Operation.	AR 750-5
Modification of Ordnance Matériel	SB 9-38
Motor Vehicle Inspection and Preventive Maintenance Services	TM 37-2810
Ordnance Maintenance: Carburetors (Stromberg)	TM 9-1826B
Ordnance Maintenance: Carburetors (Zenith)	TM 9-1826C
Ordnance Maintenance: Fuel Pumps	TM 9-1828A
Ordnance Maintenance: Electrical Equipment (Eclipse-Pioneer)	TM 9-1825C
Ordnance Maintenance: Electrical Equipment (Bendix-Scintilla)	TM 9-1825E
Ordnance Maintenance: Vehicular Maintenance Equipment, Grinding Boring, Valve Reseating Machines and Latches.	TM 9-1834A

f. OPERATION.

Full-Track Armored Infantry Vehicle T18E1	TM 9-755B
76-mm Gun Tank, T41E1	TM 9-730

g. SHIPMENT AND STANDBY OR LONG-TERM STORAGE.

Army Shipping Document	TM 38-705
Catalog of Approved Packaging Instructions for Major Items and Spare Parts for Ordnance General Supplies.	PS 1000**
Instruction Guide, Ordnance Packaging and Shipping (Posts, Camps, and Stations)	TM 9-2854
Marking and Packaging of Supplies and Equipment: Marking of Oversea Supply	SR 746-30-5
Ordnance Storage and Shipment Chart, Group G, Major Items and Major Combinations of Group G.	TB 9-OSSC-G
Preparation of Unboxed Ordnance Matériel for Shipment	SB 9-4
Protection of Ordnance General Supplies in Open Storage	TB ORD 379
Shipment of Supplies and Equipment: Report of Damaged or Improper Shipment (Reports Control Symbol CSGLD-66 (Army)).	SR 745-45-5
Standards for Overseas Shipment and Domestic Issue of Ordnance Matériel Other Than Ammunition and Army Aircraft.	TB ORD 385
Storage, Inspection, and Issue of Unboxed Serviceable Motor Vehicles; Preparation of Unserviceable Vehicles for Storage and Deprocessing of Matériel Prior to Operation.	SB 9-63

**Copies may be obtained from the Raritan Arsenal Publications Division, Metuchen, N. J.

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